# SCIENTIFIC AMERICAN



## JUNE 1925




**VACATION GEOLOGY**

35¢ a Copy

$4.00 a Year

# *As like as two ~~peas~~ telephones*

WHEN Nature develops a good pattern, she doesn't throw it away every year. Neither does Western Electric. Long ago we learned the economy of simplification in manufacture—making millions of telephones exactly alike.

And that means exactly alike not only in outward appearance, but also down to the little screws and mica washers and magnet coils inside. Each of the 201 parts in your telephone is interchangeable with the corresponding part in your neighbor's telephone.

Making many parts to one pattern instead of to many patterns simplifies the whole manufacturing process. The thorough application of this principle is one of the fruits of the long experience of Western Electric—since 1877 makers of the nation's telephones.

Instead of "as like as two peas," why not say "as like as two telephones?" To the smallest detail one telephone is a "speaking likeness" of another.

Here is a powerful press punching one of these telephone parts out of sheets of brass—just as cookies are cut out of strips of dough.

# Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

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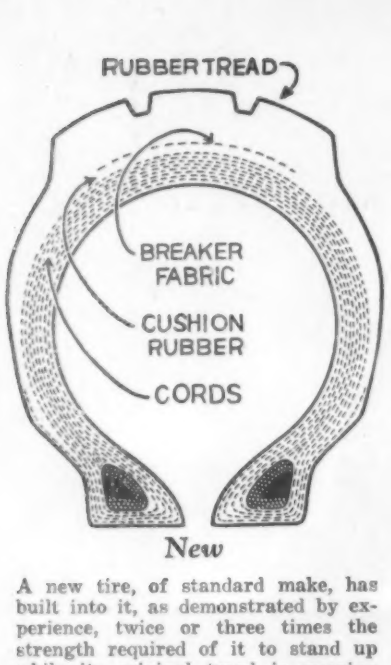
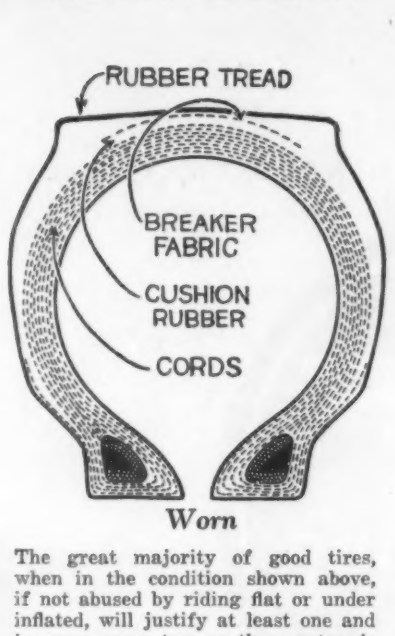


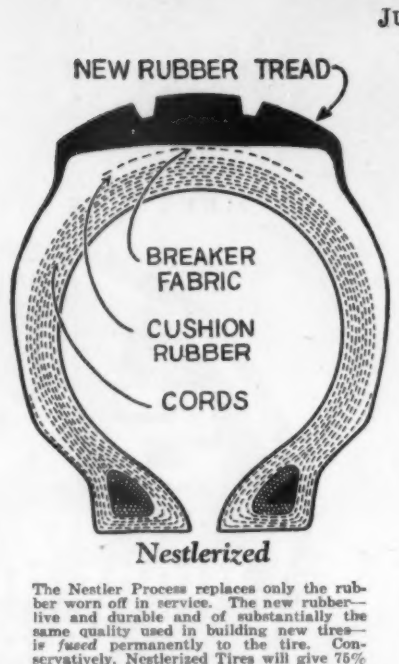

*New*

A new tire, of standard make, has built into it, as demonstrated by experience, twice or three times the strength required of it to stand up while its original tread is wearing down.




*Worn*

The great majority of good tires, when in the condition shown above, if not abused by riding flat or under inflated, will justify at least one and in some cases two or three retreads by the Nestler Process.




*Nestlerized*

The Nestler Process replaces only the rubber worn off in service. The new rubber—live and durable and of substantially the same quality used in building new tires—is *fused* permanently to the tire. Conservatively, Nestlerized Tires will give 75% of the mileage delivered by the same tire in the same service. This statement is borne out by practical experience.

# *The* Nestler Rubber Fusing Process *wants*
## State Distributors—and more Licensees
### *—a thoroly sound proposition in theory and practice*

*Emil Nestler*

The Nestler Rubber Fusing Process and Nestler Equipment were both invented and developed by Emil Nestler, an officer of this company, an engineer and tire man of more than 25 years' experience. As a result, the Nestler Process and Equipment are thoroughly practical, from every point of view.

BEFORE AFTER

The Nestlerized Tire is renewed in both looks and wearing qualities. A new non-skid tread of practical design replaces the tread that has been worn off. On the car, the Nestlerized Tire looks like other tires.

JULY, 1924, eleven months ago, this paper, the "Scientific American," printed one of the first accounts of the Nestler Rubber Fusing Process, saying: "A way to join rubber to rubber—new rubber to old—so that they actually fuse together just as two pieces of electrically welded metal fuse together, has long been needed. Such a process has now made its appearance."

The history of the Nestler Process began with its discovery in 1917. In 1920 it was patented. More than four years were consumed in research and experimenting before machinery and equipment could be made that would match, in efficiency, the process with which they were to be used. The first Nestler Equipment Unit was sold less than eighteen months ago.

The pioneer Nestler Licensees, who are operating this equipment in their communities, bought on faith with their judgment backed by what they saw and not by any facts that could be offered them.

Experience has proved the Nestler case. Rubber Fusing has made good. Questions have been answered by experience.

Will a tire retreaded by the Nestler method stand up—wear—deliver mileage? Experience says, Yes! Of thousands of tires retreaded the percentage of failures is no larger than with new tires. 5,000 seems the minimum mileage; records of 12,000 and more miles are common.

Can the operation of the Nestler Process and Equipment be mastered by the average individual? Yes, says experience! Nestler Plants now dot the country. Successful mastery of the method and a high quality of work has been the rule with so few exceptions as to be negligible.

Is the venture profitable to the Nestler Operator? Again experience says, Yes! With an average investment of less than $1,000, earnings of $50 to $150 per week with some larger earnings have been reported. Sound businesses of permanent year-round character have been established.

The Nestler Rubber Fusing Process is now ready for larger operations. With its case proved in the court of public opinion, it asks for the help of alert men and promises an unusual opportunity and gratifying potential earnings.

We want Distributors to do that personal selling and demonstrating in their own sections, that has been demonstrated to be so effective by our own organization in and near New York. What we have learned is to be placed at the disposal of our distributors. We have a carefully conceived plan. It is a business proposition that will appeal to a business man. Only moderate capital is required, considering the possibilities. The matter of overhead is eliminated by the earning power of demonstrating equipment. We can show that intensive cultivation of the market is justified by the permanent character of the relations established.

We make an appeal to successful men who want to increase their opportunities.

On request, we will gladly lay preliminary information before you by mail. We would expect that final arrangements would be made in personal conference. Prompt action is desired. Some territories have already been assigned. Others will go quickly. Write, wire or call at once and do not miss this opportunity.

NESTLER RUBBER FUSING CO., Inc.
245 West 55th St., New York City

NESTLER RUBBER FUSING STATION TIRES

**IN A FIELD ALL ALONE, IN A PLANT OF YOUR OWN.**

TO the individual desiring a highly profitable business of permanent character, in his own community, the Nestler proposition makes a unique appeal. It is a manufacturing and merchandising business combined. It consequently pays large profits. Ask for our booklet, "Be President of Your Own Company," which gives the full story, all at once. Exclusive territories are assigned and full cooperation is given by this company. Write today because only by prompt action can you be certain of not missing the territory of your choice.

*One or more Nestler Operators in each of these places*

*List growing daily*

**THE WORLD IS CHOOSING NESTLER FUSING**

CALIFORNIA
San Francisco
CONNECTICUT
Hartford
New Britain
New London
Plainfield
GEORGIA
Atlanta
HAWAII
Kohala
IDAHO
Kellogg
ILLINOIS
Chicago
Onarga
MASS.
Lynn
Pittsfield
South Weymouth
New Hampshire
Manchester
NEW JERSEY
Carlstadt
East Orange
Guttenberg
Hackensack
Perth Amboy
Point Pleasant
Ridgewood
NEW YORK
Beacon
Binghamton
Brooklyn
Buffalo
Corona, L. I.
Jamaica
Long Beach
Mount Vernon
New Rochelle
New York City
PENNA.
Berwyn
Philadelphia
Scranton
Wilkes Barre
RHODE ISLAND
Westerly
TEXAS
Fort Worth
San Antonio
WASHINGTON
Seattle
PORTO RICO
San Juan
FINLAND
Helsingfors
SPAIN
Barcelona
TASMANIA
Launceston

### VACATIONS

THE trouble with vacations is that they have a way of being just what their name implies—too vacant. Few human experiences are worse than that of the individual who finds himself sitting around in the country or at the seashore with twenty-four hours a day on his hands and nothing interesting to do with it. And to go off far away where there is something new to see or some really interesting thing to do means too large an investment of time and money for most of us.

Here is where science can help. Anywhere in the out of doors there is opportunity for real fun with science. In this issue Mr. Ingalls tells you some of the interesting things you can do and see with rocks and streams and the sides of hills. On another page Mr. Talman tells you some secrets of the clouds. Next month there will be more vacation science.

### MUD

ANOTHER good way to make your vacation interesting is to study mud. In the bottoms of sluggish streams and small fresh-water ponds, even in the bottoms of the water-filled ditches along the roadside, there is a vast and interesting world of tiny creatures. Science calls them animalcules, protozoa, protophyta, other long names. You cannot see them at all without a microscope.

But for the price of one week-end visit to a moderately fashionable resort you can buy a microscope. You can take it out anywhere in the country and discover for yourself this intensely interesting world of the mud dwellers. There are books which will tell you, without difficulty, just what each of these microscopic creatures is.

### STATIC

IF you take a radio set on your vacation, even a small and portable one, there is something you can do that may have real scientific value. Compare the static with the weather. We mean, of course, the visible facts about the weather; the forms and heights of clouds, the wind, any rain or mist, the intensity of the sunlight, other things of that kind.

Radio engineers know that static is due, largely, to electric discharges in the air. Lightning causes a lot of static. But there are kinds of static the exact cause of which is not known. More facts are needed. Anyone who knows even a little about radio can help to get these facts.

### STEEL

IN this issue we conclude the series of articles on the Story of Steel. A number of readers have asked us to reprint these articles in book or pamphlet form. We are willing enough to do so, expenses and profits quite aside, if there is a real need for this material in schools or elsewhere.

Do *you* want these articles in permanent form? What do you want them for? If they will be of practical or educational service to enough people you can have them.

# In This Issue

***How to be Happy on Your Vacation***

Science is not the dusty, dry, disagreeable thing that some people still imagine it to be. Instead it can give you more fun than a party. Read what Mr. Ingalls has to say on page 365 about vacations among the rocks.

***Another Mystery About Insects***

Do insects have more than the five senses that we have? Or do they have fewer? We know that most of them can see. Many can smell. On page 390 Mr. Aaron tells us that few of them seem able to hear. Do they have some mysterious sixth sense which helps them find each other and their food?

***Weather Signs in Summer Skies***

When you glance up these bright spring days at the drifting argosies or tumbled turrets of the clouds do you know what they mean? How are they named? What do they show about weather? Mr. Talman tells on page 375.

***New Discoveries About Boats***

The art of rowing boats is almost as old as man. Centuries ago rash voyagers crossed both oceans in frail shells propelled by oars. Nevertheless new facts continue to be discovered. If you ever rowed a boat read page 368.

***A Star That Seems to Breathe***

The mysterious star named Mira—a word meaning "wonderful"—has been measured at the famous Mount Wilson Observatory. Professor Russell is now at Mount Wilson. On page 385 he gives us at first hand the amazing facts about this star, how it seems to pulsate almost as though it were alive.

MORE THAN ONE HUNDRED PICTURES

*Complete table of contents will be found on page 432.*

# For Next Month

***Your Summer at the Seaside***

There is vacation fun to be had out of science at the seashore too. For our July issue—out June 20th—Dr. Roy W. Miner, distinguished naturalist of the American Museum of Natural History, has written of the amazing creatures which you can study along the beach.

***Shall We Use the Air for Freight?***

As predicted long ago by the Scientific American, commercial aviation grows with unprecedented rapidity. Air mail lines, air passenger lines, air freight lines; all exist. Europe is ahead of us. How far ahead we will tell in the next issue.

***New Worlds From the Test Tube***

Modern industry is a creation of chemists. New products, new processes; on these world commerce is built. Dr. Harrison E. Howe, one of America's great chemists, has written a series of articles on the fundamental chemistry of world affairs. They begin in the July issue, out June 20th.

Other articles on Scientific Fire Fighting, on Salvaging the Frigate Constitution, on The Lost City of Nevada, on Theory of Engine Balance.

MORE THAN ONE HUNDRED PICTURES



### RHEUMATISM

ONE of the mysteries of meteorology is grandpa's rheumatism. Meteorology is the science of weather. One of its purposes is to predict the weather. That is what the Weather Bureau does with its daily forecasts. On the whole the Bureau does its job well. But grandpa's rheumatism does about as well, maybe better. No one knows why this is true. But it is.

There exists some mysterious effect of the weather on the human body. It is not a mere effect of temperature or of sunlight or any other visible thing, although these things do have their influences. It is something much more subtle. Some days everybody feels happy and energetic. Other days everybody is depressed. Grandpa's bones detect storms that are still many miles and several hours away. A number of scientists are working on these problems. Here's hoping they find out rheumatism's secret.

### AIRWAYS

THE Scientific American has been, always, a pioneer in urging the conquest of the air. Months ago we began, in the form of Professor Klemin's articles on dirigibles, the present agitation for the commercial use of aircraft. No less a personage than Henry Ford now admits his belief that we were right.

Years back Mr. Walker of our staff worked out some basic principles of airplane design. Now they are embodied in some of the newest plans. Mr. Walker describes them in this issue.

### CANCER

A FEW months ago we mentioned some new French experiments on cancer. They did not entirely succeed. There has been, however, a little progress. Heat rays of certain special kinds have been found sometimes beneficial. This is not a cure. Nevertheless it is a step ahead.

At the same time German scientists have discovered further relations between cancer and certain diseases of agricultural plants. What this will mean practically, if anything, is still unknown. But gradually scientific men are closing in on this ancient and terrible enemy of human life.

### MONKEYS

THE Legislature of Tennessee has forbidden the teaching of the theory of evolution in state-supported schools. Three other southern states have taken similar action. Mr. Bryan, sincere enough, but ignorant and mistaken, continues to employ his eloquence against this "menacing" doctrine that man and monkeys are more or less akin.

This is quite all right. We believe in evolution. That is why we are glad to see it attacked. The best way to establish any doctrine—provided, of course, that the doctrine is true—is to hire some vigorous chap to attack it. Evolution being now forbidden in Tennessee, every schoolchild will presently know all about it. It is bootleg knowledge.

Mr. Bryan is a great help to the cause of evolution. More power to him.

EIGHTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JUNE, 1925

# Out of Doors With the Earth

## With a Simple Vacation Equipment, the Amateur May Easily Learn the Meaning of the Earth's Ever-varied Geological Features

*By Albert G. Ingalls*

CAN one who is not a professional geologist understand and interpret the scientific meaning of the earth's features? Can he learn to explain the origin of the mountains, rivers and lakes as he motors along a country highway, as he tramps over the fields and hills, or even as he sees them from the window of a railway coach? How much scientific knowledge, and fun, could a vacation camper get from a week's observation of the geological features in the neighborhood of his camp? Could it be done without any trained instructor? What special implements are necessary?

These are some of the questions which the postman frequently brings to the editors of the Scientific American. They indicate that many people are at least interested in geology. Many are interested in evolution and they have found that the story of organic evolution is closely related to the science of geology, for the fossils of the ancient sea and land animals representing the stages of evolution are found in the rocks. People want to find these fossils and learn to assign them to their proper place on the great family tree of the evolution of life.

They also want to know the origin of Mammoth Cave, Crater Lake, Niagara Falls, the Grand Canyon, Great Salt Lake, and many other natural phenomena.

But the feeling that geology is involved and difficult to understand holds them back. Some of it is; but the elementary part, the part which suffices to explain the most usual earth features is just common sense, coupled with ordinary powers of observation, the use of the imagination to visualize conditions that existed millions of years ago, and a little reading to supply the theory.

The amateur geologist does not require an elaborate outfit, for the principal adjuncts to geology are the hills and rocks themselves. This year when you take your vacation, include in your luggage a geologist's hammer, a small notebook, a map and any kind of a strong knapsack. A notable book on geology is, Pirsson and Schuchert, *Text-book of Geology* (John Wiley and Sons). A shorter book is Platt's *Popular Geology* (The Macmillan Co.). Excellent maps of many localities are published by the United States Geological Survey, Washington, D. C. In a short time, with these few items, you can acquire a good insight into geology.

### Where to Look for Fossils

Why is it that the hilly farms of New England are covered with rounded granite boulders, while there are many whole states in which it is hard to find a stone big enough to throw at a cat? Why is the soil red in the south, and gray or drab in the north? Why do some mountains look as if they had actually been folded up by some giant force, while others have flat tops and are made up of level strata of rocks? These are some of the more obvious things the amateur geologist will wish to answer, and the answers are quite easily obtained.

First, however, he must learn to recognize a few of the commonest rocks. Let us suppose that you start out, some sunny morning, with your knapsack and rock hammer, a put-up lunch and a map of the locality in which you intend to geologize. When you come to an exposure of rock, break off a sample and trim it to a neat specimen size.

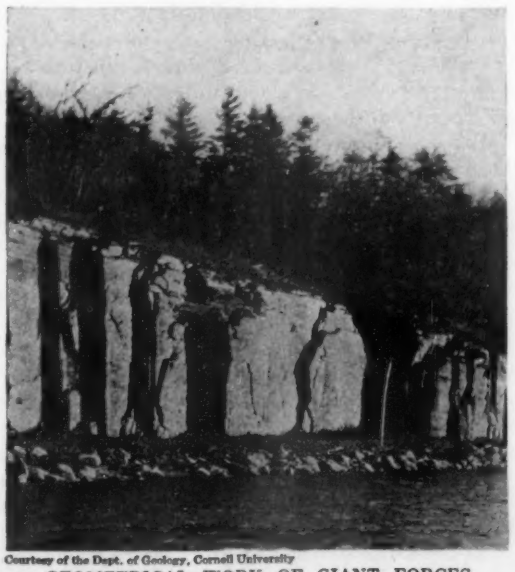
Trimming specimens of rock is something of a knack. When one first tries it, the rock does not break off where one intends. A geologist seems to know, however, how to trim the same stone into a neatly shaped specimen. When he strikes it, the desired pieces fly off, and no others. The secret is this: Hold the rock in the hand, and keep it at an angle, *sloping down toward your knees.* The piece will now fracture where you hit it.

There are three great divisions of rocks, the igneous, which have been formed from molten masses—for example, granite; the sedimentary, which have been formed under water by the deposit of sand and other sediments and later consolidated—for example, sandstone, shale; and the metamorphic, which are rocks of either of the foregoing divisions which have been changed or metamorphosed by heat, pressure or chemical action into rocks of a different nature. Thus limestone is metamorphosed into marble; shale becomes slate; sandstone becomes quartzite.

The distinguishing characteristic of igneous rocks is that no matter in which direction you break the specimens the surface looks the same. They are not stratified. Their texture is usually made up of a granular mass of two, three or four kinds and colors of component mineral particles of varying size.

Igneous rocks are disintegrated by frost and other natural forces, and their components are carried down towards or into the sea to be redeposited in layers which may later become consolidated into sedimentary rocks.

If you are interested in finding the fossil remains of some of the animals which lived millions of years ago, look for them only in sedimentary rocks. With



Courtesy of the Dept. of Geology, Cornell University

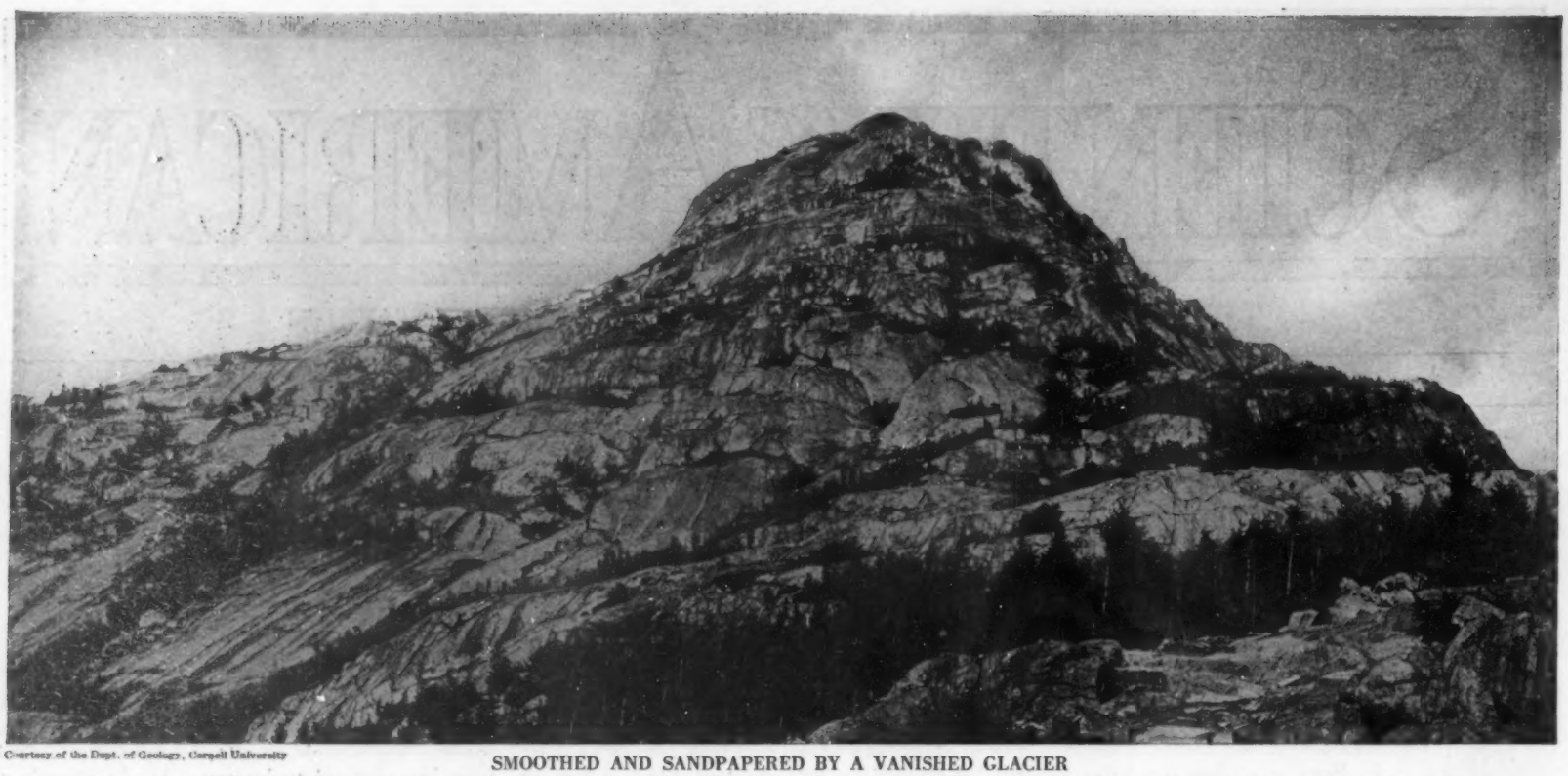
GEOMETRICAL WORK OF GIANT FORCES

*Movements of the earth's crust frequently break the rocks into great blocks bounded by joint planes. Finger Lakes region, Western New York*

Courtesy of the Dept. of Geology, Cornell University

SCARRED BY A MILLION-TON PLANER

*Deformation of the crust of the earth often causes vertical movement between great fault blocks, sometimes producing slickenslides as they grind together*



Courtesy of the Dept. of Geology, Cornell University

SMOOTHED AND SANDPAPERED BY A VANISHED GLACIER

*Bare and rounded rock contours are the work of moving ice armed with cutting tools of harder rock. Stream erosion alone could not produce such graceful outlines*

your hammer, split the strata apart and look for fossils on the surfaces of the fragments. Places in which there are alternating thick and thin strata of rocks, particularly limestones, are more favorable for the discovery of fossils than places where the rock is in homogeneous, thick strata.

Suppose you should find some ancient fossil; for example the extinct trilobite, a small, primitive, swimming animal from which some believe the horseshoe crab is descended. Can you picture the shallow sea-bottom on which that dying animal fell millions of years ago? Remove, in your mind's eye, all the strata of rock that lie above the level of your little fossil, for these strata were deposited after this trilobite died.

To complete the picture of the local conditions of that early day you will have to build on your imaginative powers to a still greater degree. The rocks which have since been hewn by streams into deep valleys were then continuous and horizontal. Moreover, they were then below the level of the sea. The raising up of immense areas to higher levels is quite common in geology, so do not refuse to credit the sea-level origin of these rocks, even though you should find them on the top of a high mountain.

When you have finished reconstructing your imaginative picture of the original conditions under which the trilobite was entombed countless centuries ago, there will be very little of the present landscape and present physical conditions left in it. A geologist must indeed exercise his imagination.

### Prospecting Is Fun

In addition to the hunt for fossils you may find it interesting to go prospecting for valuable minerals. This, however, is not so simple a study, for most of these minerals are well disguised. People pass daily within sight of good indications of ores without recognizing them. Few of the ores resemble the refined metals. A brief study of mineralogy should be made from some of the numerous prospector's pocket manuals; and from a small collection of labeled sample minerals which can be secured from some dealer in scientific materials, such as the Ward Natural History Establishment (Rochester, N. Y.).

Gold may be washed from the gravel in creek beds in the Appalachians and in some parts of the West with any common tin pan having sloping sides. There is a peculiar knack of manipulating the pan to wash away the gravel and sand without losing the heavier gold. In the Adirondacks one may find a small amount of gold by this method. It will not repay your labor, financially, but it is a satisfaction to see the "colors" in the bottom of the pan. If you get the gold fever, remember that the gold of these mountains is too thinly disseminated through the rocks to repay the cost of recovery.

A third and equally interesting phase of earth science is dynamical geology, the study of the powerful forces which have modified the face of the earth into its present form. These forces continue to act on the earth's crust, just as they always have, and at about the same rate of speed. The so-called "awful cataclysms" of the past are not held by science to have taken place. It is true, the shape of the continents has been radically altered many times in the past, but these vast changes occurred so gradually that they would not even have been noted by any single observer. In fact, mountains are being pushed up today, but we do not notice any difference in height. Our lives are too brief.

TRIMMING SPECIMENS IS A SIMPLE KNACK

*Hold the piece at an angle and strike off the excess, bit by bit*

One can learn to interpret these giant processes of tearing down to build again elsewhere by learning the basic principles by which they work.

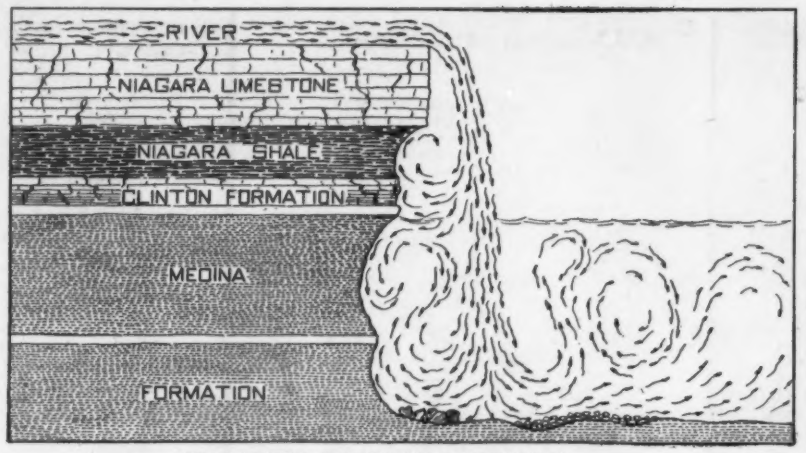
### What the Ice Age Did to America

Standing on some elevated prominence overlooking a flat valley in which a river winds its way, you wonder why is it so crooked? Why does the river not flow straight down the valley, covering half, or perhaps only one-third, of its present distance? Were you to straighten it by means of a dredge it would not remain straight, for some small obstruction would soon throw the current glancingly against one bank and that bank would be cut away for a distance by the stream. From this one bank the water would then be deflected to the other, cutting that in turn. Thus within a short time the stream would again build up a system of meander curves. The material cut away at the impinging points of the stream is partly deposited on the same bank lower down. In this manner these broad curves slowly shift from one side to the other side of the valley, often becoming so looped that they meet.

Glaciers are most powerful agents for modifying the features of the earth. Less than a million years ago the North American continent was invaded by a great, continuous sheet of ice very much like that which still covers most of Greenland. Perhaps it was over a mile thick. It persisted here until about 25,000 years ago and the evidences of its work are today clearly decipherable to the geologist.

Canada and most of the area north of a line reaching from New York City across Northern Pennsylvania, Ohio, Illinois and in a crooked line as far west as Montana, were glaciated by the great ice sheet. The ice scraped up most of the soil and rocks which stood in its way, incorporated them into its own mass and used them as powerful cutting tools to wear away other rocks.

As the ice finally melted back, the rock and soil which it had plowed up and moved many miles were left along that line and along other indefinite lines further north. Much of it is gravel, but some




WHY THERE ARE FALLS AT NIAGARA

*Waterfalls result when a stream flows from hard rocks over softer rocks, wearing away the latter faster than the former*

MAMMOTH CAVES AND NATURAL BRIDGES

*Weak acids in underground waters enlarge the fissures of limestone formations into long caves. When the roof partly caves in, natural bridges are sometimes left*

of it is in the form of great boulders of igneous rocks transported from north to south and left behind. These are the "hard-heads" of the New England farms.

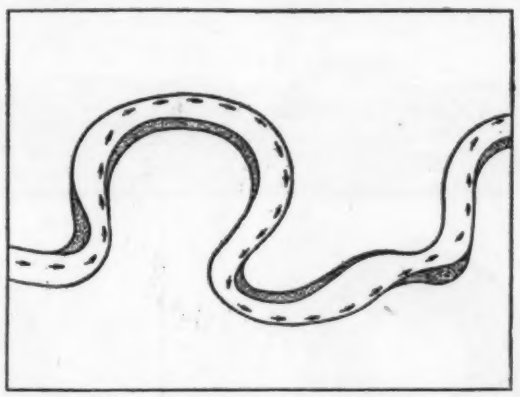
Before the glacier came, the soil in the north was brown, just as it is today further south where the glacier did not reach. The soil in the north was removed by the ice, and other soil composed of freshly ground-up rock was left in its place. Because this new soil has not yet had time to oxidize it is still gray or drab. Sometime it, too, will turn red, but not for many thousands of years.

The glacier dug some of the stream valleys very much deeper, and when it finally melted back it left behind it large enough quantities of gravel and sand to plug up the northern ends of many of these valleys. Thus the Finger Lakes were formed in New York State.

### How Most Mountains Are Made

A man can bend a rather thin sheet of steel with his own hands. The incomparably greater stresses of the earth have in the past folded up rocks which were thousands of feet in thickness, just as you would fold a thick magazine, and they still do so.

Rocks that would be brittle to quick deformations of this sort were gradually bent without much fracture by forces acting over great lengths of time. Such mountain folds are shown to exceptionally good advantage to the motorist who crosses the Appalachians through any one of the numerous water gaps in these mountains. Here their cross-sections are exposed. The streams existed before the folds were made; since the folds took place slowly, the streams eroded their beds downwards as fast as the mountain folds rose up. Therefore, these antecedent streams maintained their old channels and the nature of the adjacent rock folds is beautifully displayed where these channels pass through the mountains.



WHY RIVER CHANNELS MEANDER

*The bank is steadily cut away where the current moves most swiftly (note arrows); while new land is continually being built up in the slow-moving waters opposite*

Limestone is composed mostly of the carbonate of calcium. Acid attacks it strongly. Rainwater contains carbonic acid taken from the air by the rain. This acid gradually eats the limestone over which it flows, leaving irregular surfaces and sometimes enlarging small underground fissures to such an extent that they become caves. In Kentucky such caves are numerous. It was in one of the smaller ramifications of one of these caves that Floyd Collins was recently entrapped.

Often there is a displacement of one of two jointed rock masses with regard to another, generally in a vertical direction. Such displacements are called faults. If they occur suddenly they cause shocks. Shocks of this sort, produced by the slipping of large earth masses are thought to account for earthquakes. Faults are most noticeable in stratified rock. There is a vertical offset or step in the stratum or strata. The San Francisco earthquake was caused by a fault line four hundred miles in length and roughly parallel to the seacoast.

### Go Out Into the Open Country

One could go on indefinitely describing the interesting phenomena of the earth's surface. The best way to understand them, however, is to get out and see them, at the same time learning their significance from some good book on geology.

You may not understand all that you see if you spend part of your vacation geologizing, but the keen interest in geology which this form of vacationing will awaken in your mind will lead you to spend many an interesting evening next winter reading about earth science. The field of observation is unlimited and ever-varying. Finally, it takes one out of doors and into the country, where man naturally belongs.

Courtesy of the Dept. of Geology, Cornell University

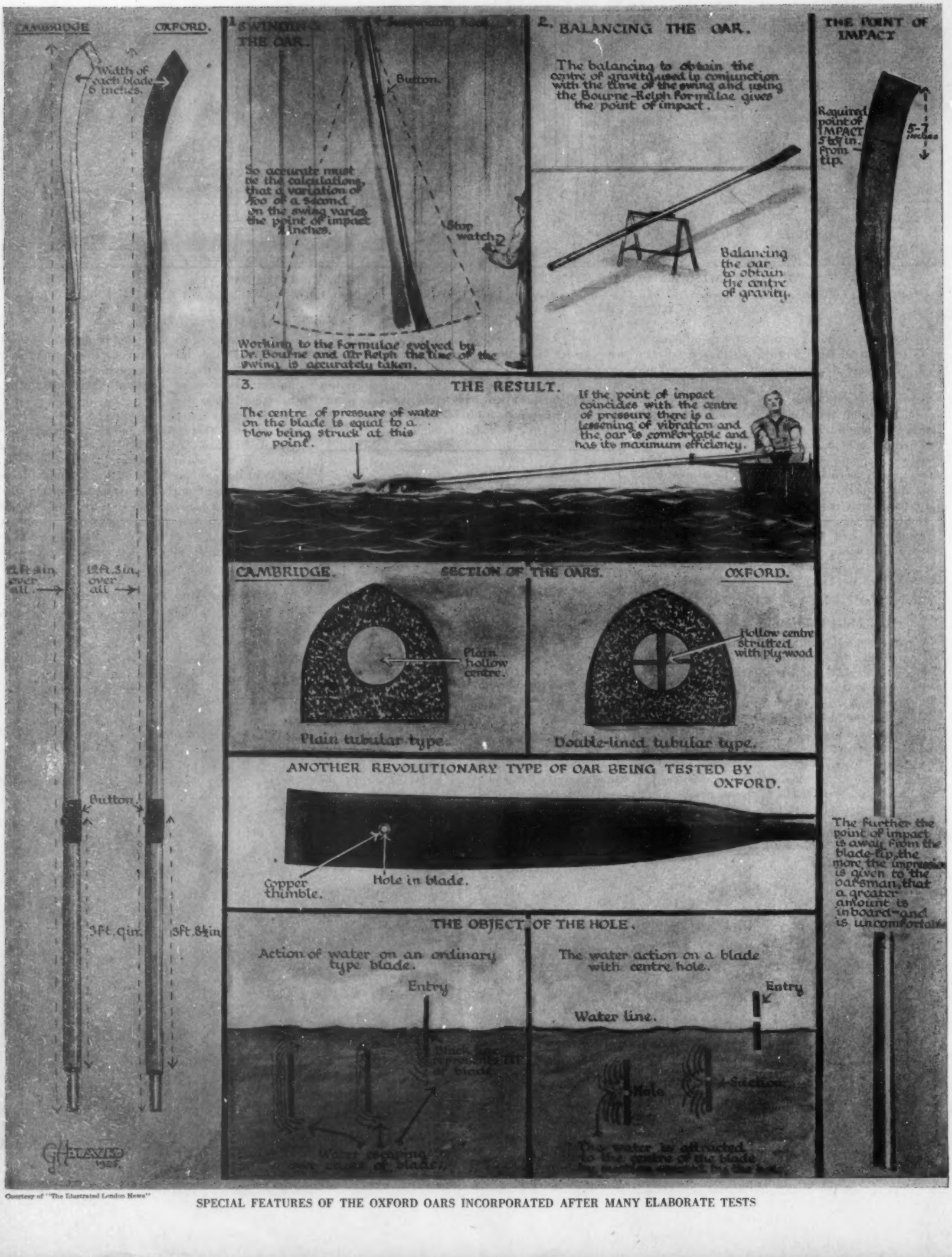
ROCKS BENT IN THE IRRESISTIBLE VICE OF NATURE

*Lateral movements of large areas of the earth's crust crumple the horizontal strata of rocks into great continental washboards*

Courtesy of W. C. Alden, U. S. Geol. Survey

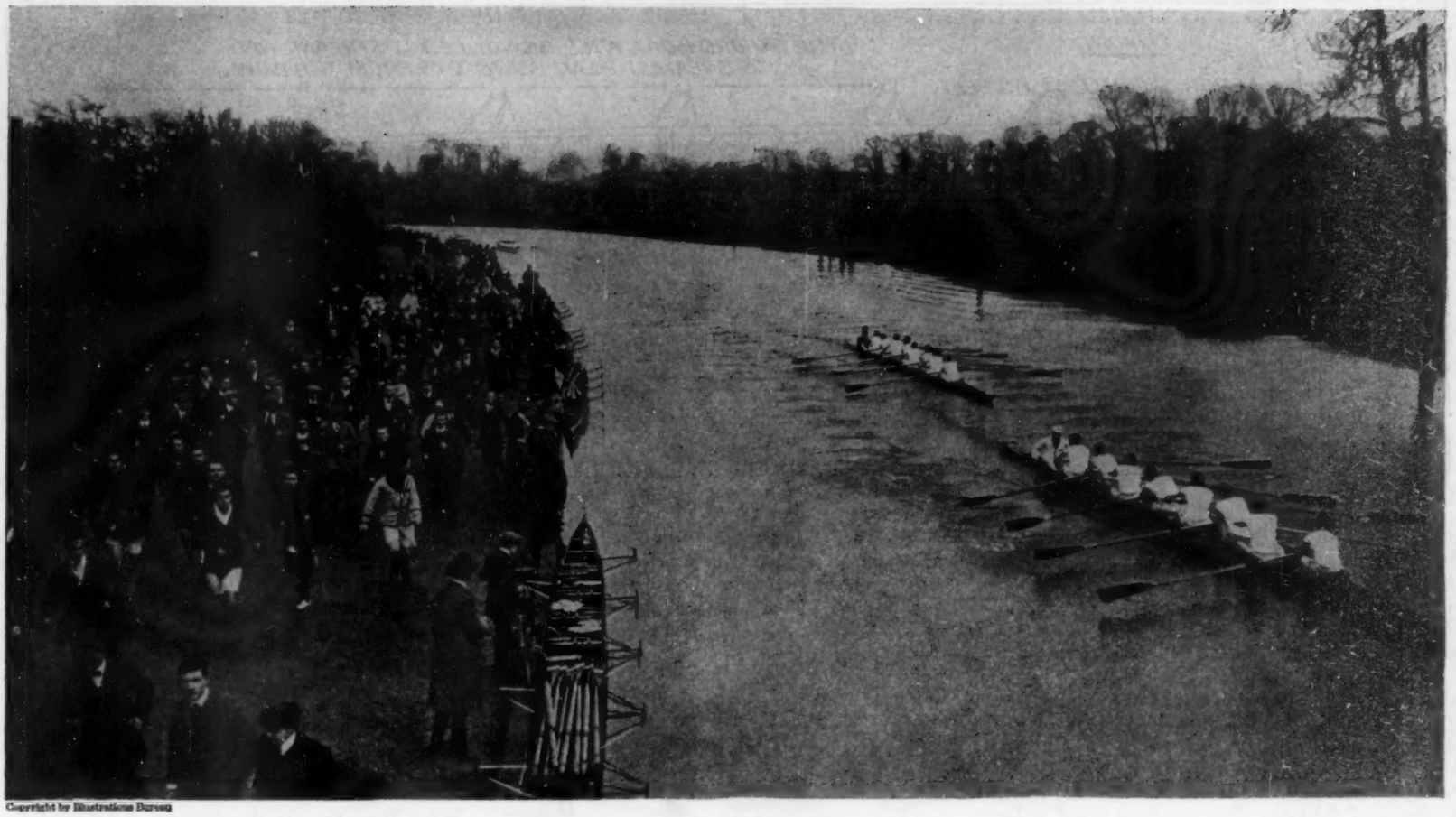
IN WHICH DIRECTION DID THE GLACIER CREEP?

*Striae scratched on the rocks by sharp stones embedded in former glaciers indicate accurately which direction the ice moved*




Courtesy of "The Illustrated London News"

SPECIAL FEATURES OF THE OXFORD OARS INCORPORATED AFTER MANY ELABORATE TESTS





# The Oxford and Cambridge Boat Race

## Some of the Scientific Refinements in the Oxford Shell

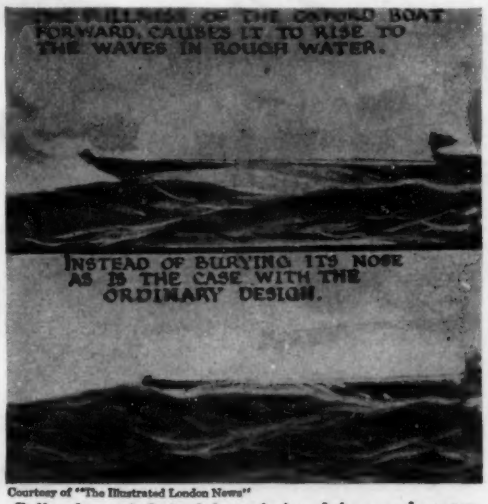
*By J. Bernard Walker*

AMONG all the water-borne sporting craft which have been developed with the special aim of obtaining high speed, there is none into which has been put more careful thought and superfine construction than the racing shell, whether it be the dainty one-man craft or the large eight-oared shell in which the great intercollegiate races are rowed. In all power-driven high-speed craft—the sailing yacht, the motor boat, or the racing shell—the problem divides itself naturally under the two heads of the motive power and the boat itself.

In the case of the racing yacht, the motive power is the wind; in the speed boat the gasoline engine; and in the eight-oared racing shell, man-power only is available. In the sailing yacht, for a given wind velocity, the motive power is a question of the cut of the sails and their skillful handling. In the case of the speed boat, it is a question of crowding the largest amount of engine power into the boat and providing it with propellers that will utilize this power with the highest possible efficiency. In the racing shell, it is a matter of selecting eight lusty young men of from 145 to 185 pounds' weight, who are provided with sufficient heart and lung power and courage, to face the terrific strain of a four-mile pull on some smooth water course. In the case of the sailing yacht and the speed boat, a hundred variations may be made in the motive power and the method of applying it, according to the ideas of the sail maker and the skipper of the yacht, or of the builders of the engines and the makers of the propellers. In the case of the racing shell, once a final selection has been made of the crew, it is a matter of teaching these young fellows to put the strength of leg, back and arms into the stroke of the oars with perfect co-ordination and according to the best traditions of three-quarters of a century of rowing coaches.

With regard to the boat itself, the racing shell is subject to the same conditions that govern the speed of motor boat or sailing yacht. There is an ideal form which, for a given weight of crew and boat, will produce the fastest speed; and there is far more careful thought and experimentation put into the building of a modern shell than the general public might believe.

Particular interest attached to the Oxford-Cambridge boat race this year because of the fact that

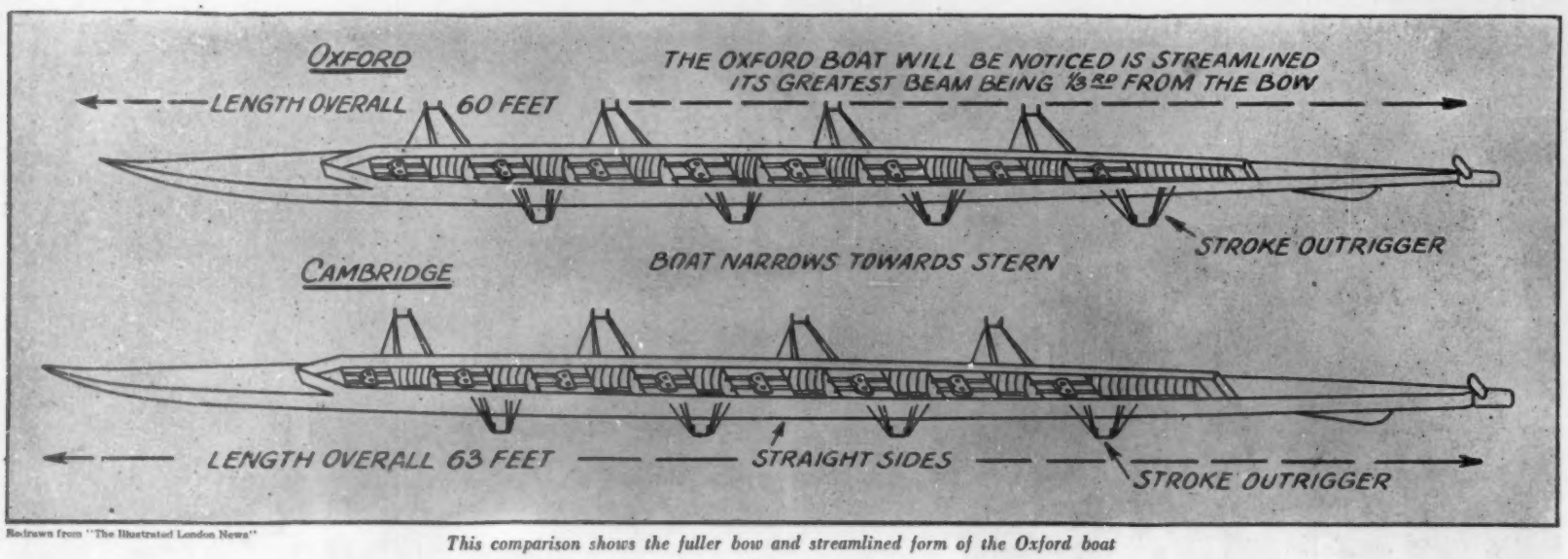



Courtesy of "The Illustrated London News"

*Fuller bow of Oxford boat designed for rough water*

there was a very marked difference in the model of the two boats, the Cambridge shell being of what might be called the conventional model, with long sharp bow and low freeboard, an equally long and fine stern, and the main body of the boat of uniform beam throughout. The Oxford boat was more of the streamline form. The greatest beam was about one-third of its length from the bow, and from that point the boat narrowed gradually to the stern post. In other words, it presented, of course in a very modified degree, something of the old codfish head and mackerel tail form which was so firmly believed in before the America made her sensational visit, in the fifties, to European waters. Moreover, the Oxford boat was shorter than the Cambridge shell, the latter measuring sixty-three feet overall, the Oxford boat, sixty feet. Not only was the Oxford boat fuller in its forward sections, but it showed a marked difference from the Cambridge shell in the fact that the Oxford keel ran up gradually to the stern post, where it was several inches above the line marking the continuation of the level keel. The Cambridge boat carried its keel in a fairly straight line throughout, so that the Oxford boat was slightly fuller forward and slighter aft. Probably its wetted surface was less than that of the Cambridge boat. The fuller sections forward and the somewhat higher bow were intended also to give the bow more lifting power when the shell was being driven into rough water.

The principal resistance encountered by a racing shell, or by any form of power-driven craft for that matter, is that due to wave-making and skin friction. Wave-making becomes increasingly important as the speed of a boat increases; and hence it is most serious when a boat is being driven at top speed.



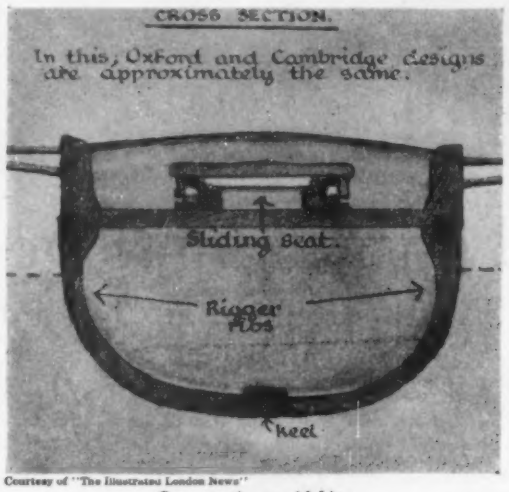

Redrawn from "The Illustrated London News"

*This comparison shows the fuller bow and streamlined form of the Oxford boat*

The skin friction, of course, depends largely upon the superficial area of the wetted surface of the boat and consequently an effort is made to reduce the wetted surface and to produce a surface of extreme smoothness, so that the water will have as little tendency as possible to cling and hold the boat back.

In earlier days, an English crew used to be seated in a staggered position—that is, the first man, let us say, sitting close against the port side of the boat, and the second man against the starboard side, and so on. Of recent years, however, they have been seating their men in the American style—that is, in the center of the boat. This has been found to be the better method and has several advantages, among which might be mentioned the fact that men sitting one directly behind the other must reduce, to some extent, the head-on atmospheric resistance.

The Oxford boat contained many wrinkles which had been worked out by Dr. G. C. Bourne, the famous Oxford coach; and he seems to have paid particular attention to the question of the oars. These oars, by the way, are about twelve feet in length overall, and they are amazingly light. We present a cross-section showing that they are built hollow, the difference being that the Oxford oars are strutted with plywood in the vertical and horizontal planes, which theoretically should give a lighter oar for a given length. A feature studied by Dr. Bourne was the question of the proper balance of the oars. This was determined by letting the oar swing from its inner end, and by balancing the oar to determine its exact center of gravity. It may be noticed from our diagram that the Oxford oars balance several feet outside of the thole pins or rowlocks. Herein is a marked difference from American practise; for our coaches prefer an oar whose center of gravity is at the thole pins, and in some cases a small plug of lead has been inserted at the inboard end of the oar.



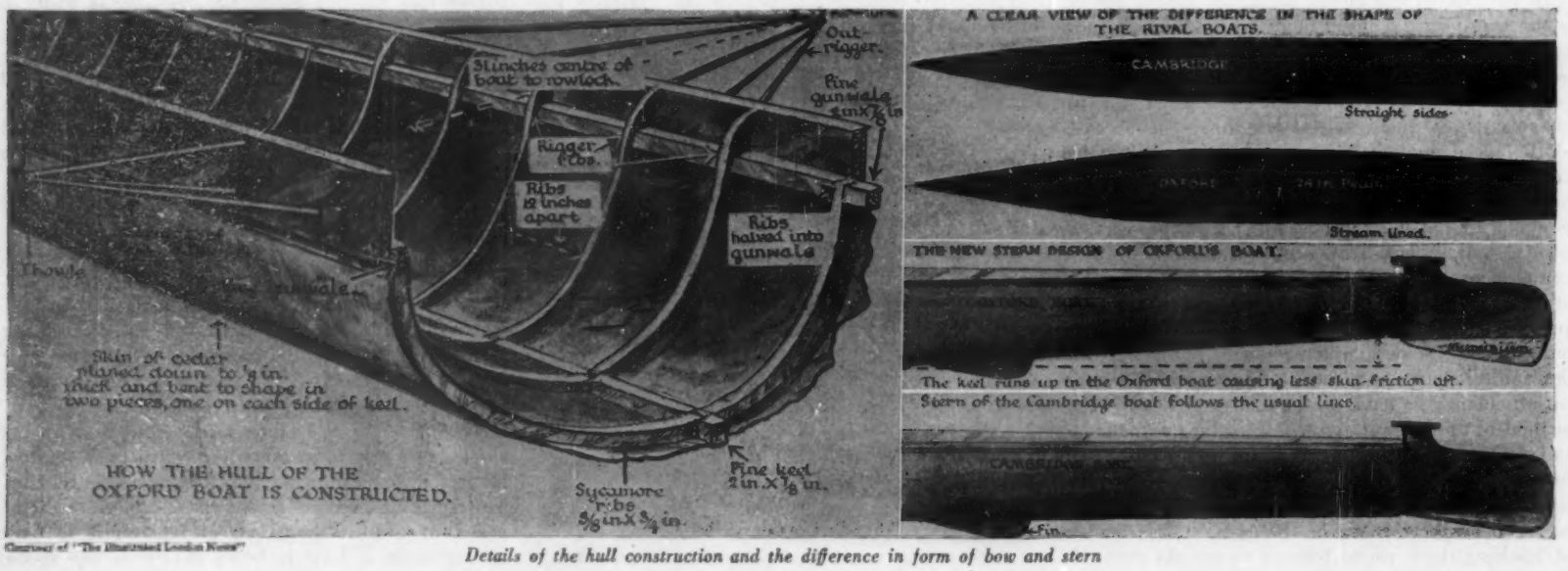

Courtesy of "The Illustrated London News"

*Cross-section amidships*

Another curious experimental device shown in our drawing is that of providing a hole in the blade of the oar, for the purpose of allowing a certain amount of the water to flow through instead of around the edges of the blade. This reminds us of the experiments which were made some years ago of providing one or more holes in the center of the sails of square-rigged ships, the idea being that more effective pressure would be obtained if some of the air were allowed to pass through the sail.

Dr. Bourne made a series of experiments to determine the best location for the center of pressure on the blade, and experimental oars were made in which this point varied from four inches to fifteen inches from the tip of the blade. The crew were requested to make criticisms, and it was found that the farther the point of impact was away from the tip of the blade, the less the oarsmen liked the oar. Dr. Bourne found that when the point was twelve inches from the tip, the oarsmen complained that the oars seemed too long inboard and felt cumbersome, although otherwise the various measurements of the oars were the same.

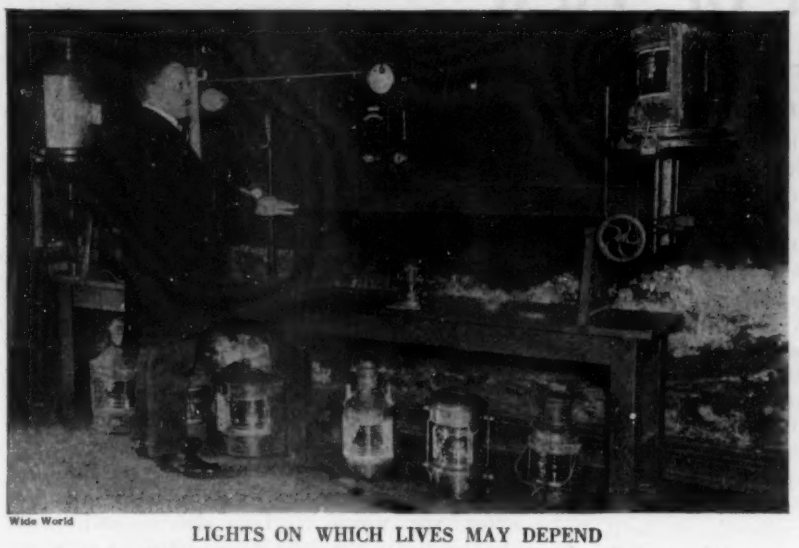
In spite of the hopes that were placed upon the new boat, Oxford was badly beaten; although this was largely due to the fact that Cambridge, winning the toss, chose the sheltered side of the river, while Oxford, being farther out, was exposed to the full force of wind and sea. In spite of her fuller bow, the spray flew so heavily over the boat that it was soon completely waterlogged and the crew had to pull ashore. It should be remembered that a first-class crew can drive one of these light shells at from eleven to twelve miles per hour. The Thames is a tidal river and when a strong wind blows against the current, a nasty little sea is kicked up. The Oxford boat began to ship water, in the form of heavy clouds of spray from the very start. Hence, the defeat of Oxford does not necessarily disprove the value of Dr. Bourne's improvements.




Courtesy of "The Illustrated London News"

*Details of the hull construction and the difference in form of bow and stern*

# How Science Aids the Safety of German Ships



Wide World

LIGHTS ON WHICH LIVES MAY DEPEND

*In the testing laboratories of the "Deutsche Seewarte," in Hamburg, Germany, this operator is certifying the exact luminosity of ship's lanterns, so that they may be issued for use at sea*

Wide World

WEATHER YIELDS ITS SECRETS TOO

*These instruments measure the air pressure and the wind. The continuous pressure recorder is at the left and a delicate barometer at the right.. In the center is the wind recorder*

Wide World

COMPARING SHIP'S BAROMETERS

*The accuracy of instruments which are to be taken to sea is thus assured*

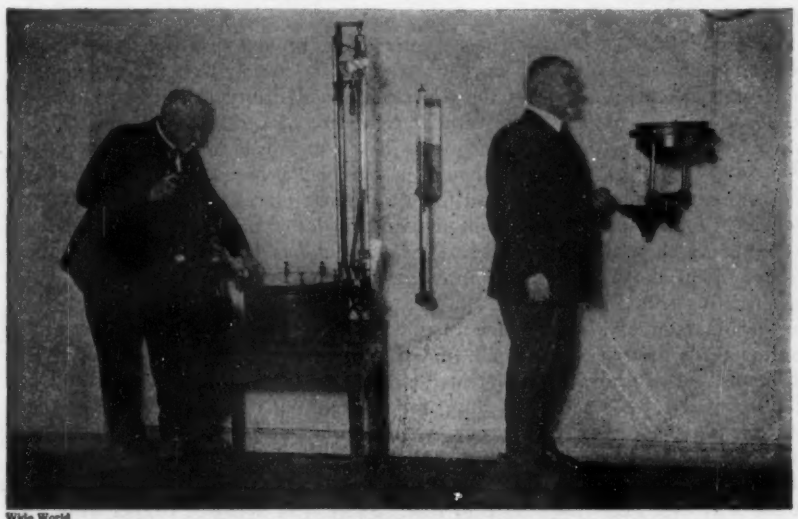
A SUNSHINE RECORDER

*The glass ball serves as a lens and writes the sun's autograph on a strip of sensitive paper*

Wide World

TESTING A SEXTANT

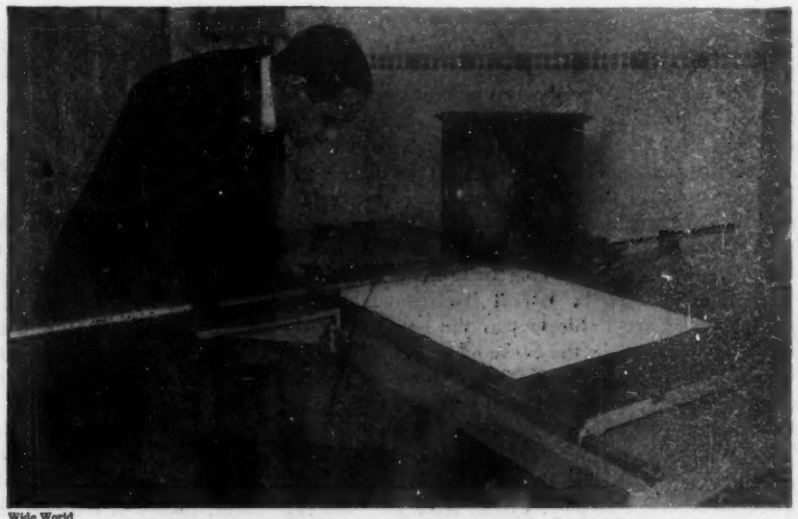
*Here the laboratory standardizes those invaluable instruments used to "shoot the sun"*



Wide World

TWO SERVANTS WHICH EVERY CAPTAIN MUST TRUST

*At the left an aneroid barometer is being tested by altering the air pressure in the small iron case, the barometer being inside. At the right a marine compass, the most important of the ship's instruments is being tested for certification*



Wide World

AN INSTRUMENT WHICH RECORDS THE COURSE OF A SHIP

*By plotting automatically the distance covered by a ship from instant to instant, as read from a logging device suspended in the water, it is possible to make the ship itself write down its path on a chart in the captain's office*

# Our Point of View

### The Los Angeles a Fine Job

FALSE propaganda and misleading half truths are the bane of modern life. Their malevolence would begin and end with themselves were it not for the wide publicity they too often obtain in the daily press and the magazine. Because of the un-American influences that have been poisoning the country during the last twenty-five years, it has come about that, if they are to be attractive, the stage must be salacious and journalism enriched with sensation and scandal.

It has been publicly stated that the metal of the Los Angeles airship is disintegrating and that this catastrophe is the result of deliberate German duplicity. That is the latest lie; and we wish it here and now to be understood that it has been deliberately cut out of whole cloth. The framework of the Los Angeles is not disintegrating, and the ship itself, as the editor can testify after climbing over every accessible part of it, is a magnificent job, both in the intelligence of the design and the characteristic thoroughness of the workmanship.

A grain of truth in these rumors is to be found in the fact that there has been a certain amount of corrosion in the keel of the Los Angeles, which has not been due to any fault in the aluminum alloy of which the frame is built, but to some chemicals which were accidentally spilt upon it during the operation of the ship. Within the hull is carried a large number of bags of water which are discharged when it is necessary to lighten the ship. With a view to preventing freezing at high altitudes, a certain amount of calcium chloride is mixed with the water, and in pouring the liquid into the bags, some of it spilled over and ran down into the keel. The calcium chloride set up a surface corrosion which, in the small lattices of which the main triangular members are built up, became sufficiently serious to necessitate their removal. This has now been done and the ship is today in first-class condition. Greater care in filling the bags with anti-freezing mixture, or better yet, the substitution of wood alcohol or some other suitable substance, would absolutely remove any similar risk for the future.

As to the suggestion that the Germans had deliberately made up an alloy which was certain to disintegrate in the course of time and so wreck the ship, the idea is preposterous. The Zeppelin company who built the Los Angeles have already become affiliated with a powerful Akron concern, and the only field for the future building by them of airships lies in this country. Consequently, there is every inducement for them to make the Los Angeles a fine exhibit of their skill in design and in construction. In other words, she is their show ship for America. Our examination of the vessel confirms the expectation of her excellence. Particularly noticeable is the construction of the bow to withstand those heavy lateral stresses which in a gale of wind are liable to tear the bow out of the ship, as happened in the Shenandoah when her cap was torn loose, and in R-33. A heavy side gust sets up tension on the lee side and heavy compression on the windward side of the ship and the aluminum alloy is relatively weaker in compression than in tension. Hence, a series of straight and stiff rectangular posts extend from the nose cap to the first circular ring, and these are strengthened in such a way that they should be proof against the heaviest stresses to which they can be exposed.

### A Side-Issue of the Great Lakes Level Problem

IN our recent talk entitled "Lowering the Great Lakes Level," we thought it best to do one thing at a time and treat the matter in a broad way, by referring to the general hardships engendered upon all the lake ports and harbors by the withdrawal of water through the Chicago Drainage Canal.

We have received a communication on this subject from the Chairman of the Committee on Pollution which has been established in the rich and beautiful Illinois Valley, through which the sewage of Chicago is being discharged in ever-increasing quantities. The object of this movement is to stop the damage which is now being done in the Illinois Valley and restore the Desplaines and Illinois Rivers to something approaching their original state of purity. It will be remembered that the flow of the Chicago River has been reversed and that by means of a connecting canal, the sewage which is poured into the river at Chicago is ultimately discharged into the Desplaines and Illinois Rivers and so carried down to the Mississippi Valley.

At one time the Illinois Valley was not only one of the most attractive in the United States, but there was a fishing industry there second only to that of the Columbia River. This, however, has been destroyed, and the loss in property values on the river front and the adjoining property has been variously estimated at from 50 to 150 millions of dollars. Furthermore, all the communities along this stream, if it were purified, would draw their drinking water from it, in a manner similar to the practise at Philadelphia and in other communities, using, of course, the method of filtration through sand. So great, however, is the sewage flow down the Illinois River that the communities doubt the efficiency of sand filtration, and they are being put to great expense in order to get a pure supply of drinking water. If the sanitary district of Chicago is made to treat its sewage, the communities in the Illinois Valley stand prepared to follow the same practise.

The river valley forces have laid all the detailed facts of the situation before the Secretary of War and wish to leave the decision entirely in the hands of the War Department, which, they feel satisfied, will make an impartial and unbiased investigation and require the Sanitary District of Chicago, which is at present the football of politics, to provide the necessary works, not only to protect the various cities bordering on the Lake against low water, but to give back to the people of the Illinois Valley their formerly unpolluted rivers.

### The Four-Day Liner

WHAT is the likelihood of transatlantic passengers being able to cross the ocean in four days? To do this they would have to travel in a ship capable of maintaining an average speed of 30 knots. The highest average speed of any existing ship for the whole passage is credited to the Mauretania, which soon after her recent overhauling made the crossing at an average speed of 26.25 knots. It is probable that the maximum speed of this vessel for a single day's run is about 27 knots, for she has actually averaged that on one or two occasions. Variable conditions of the wind, sea and ocean currents, however, render it unlikely that she will ever make the whole crossing at 27 knots. At the speed of 27 knots she must have developed at least 80,000 horsepower and to drive the ship at 30 knots in smooth water and under favorable conditions would necessitate raising her horsepower to 108,000.

It is questionable if this could be done with steam turbines. Her present motive power is of the early type, with large direct-connected turbines turning at the low speed of 180 revolutions per minute; moreover, she is equipped with Scotch boilers. If she were re-boilered and re-engined, she would carry water-tube boilers and smaller high-speed turbines with a single or double mechanical reduction gear. Thus equipped, she would undoubtedly be faster, but she would be incapable of making the required 30 knots for a four-day trip.

If ever a 30-knot ship is placed on the transatlantic passage, she will undoubtedly be furnished with improved Diesel engines of the two-cycle double-acting type, which has been showing such excellent results in the later motor ships; but in the present state of the art, we doubt if there is any Diesel engine builder who would be prepared to guarantee an output of 108,000 horsepower on four shafts. It is true that a ship designed for this speed would be given a finer form even than that of the Mauretania, and in such a vessel of the displacement of the Mauretania, 100,000 horsepower might prove to be sufficient. In that case, two engines placed tandem on each of the four shafts would call for 12,500 horsepower per engine, or say about 2,000 horsepower per cylinder. However, the development of the Diesel engine is going ahead by leaps and bounds, and its low consumption of four-tenths of a pound per horsepower-hour relieves the problem of the obstacle of high cost of operation, which renders a steam-driven ship of this speed impossible from the shipowner's standpoint.

### A Retrograde Step?

ONE of the most marked advances in the development of our railroads has been the introduction of all-steel cars not only for passenger but also for freight service. Where the design was good and steel of the right quality, the steel car has proved itself to be a great success—so much so that all the important passenger trains consist entirely of steel cars. The success of the passenger car led inevitably to the use of steel for freight cars. The problem here is somewhat different because of the greater exposure of the metal, and in some cases serious deterioration through rusting has developed. Thus, a report at the twenty-first annual meeting of the American Wood Preservation Association on preservative treatment of car lumber states that the all-steel car has not proved the financial success that had been anticipated, because the steel had been known to rust at those places where if treated wood had been used, the latter material would not have rotted. The trouble has been particularly noticeable in all-steel floors.

Now, steel construction, even for freight cars, has come to stay. It is structurally far superior to wood, and its normal life is longer. If wood can be treated with preservatives, so can steel; and the research work carried out during the past few years by our metallurgists and steel manufacturers has provided us with a steel containing a certain percentage of copper which shows a remarkable resistance to rust. Sheet steel made of copper alloy has this quality. It dries rapidly, and such surface rusting as occurs seems to act as an actual preservative.

# Herbert Hoover and the Patent Office

## The Transfer of the Patent Office to the Department of Commerce Has Produced Already One Proposal Helpful to American Inventors

THE inventors of the United States are to be congratulated that the Patent Office has by executive order been transferred to the jurisdiction of the Department of Commerce, the logical place for it, since commerce depends largely on trade based upon patent protection; and they are to be again congratulated that the Honorable Herbert Hoover is the head of that department.

The Interior Department was established by Act of Congress on March 3, 1849. By this act the Interior Department was given supervision over the Patent Office. The first section of the Act instituted the Department, and the second placed the Patent Office under its jurisdiction, where it remained until, by Executive order of the President, it was transferred to the Department of Commerce on April 1, 1925.

Secretary Hoover is eminently fitted by training and experience to direct and supervise the administration of the Patent Office. He knows that the pre-eminent position of American industry is largely based upon the protection afforded by patents, and he was quick to appreciate and point out in the article by him appearing on this page—"The primary function of the Patent Office is to stimulate and protect American ingenuity and inventiveness." He finds the Patent Office with a remarkable history for work well done and one that is now doing wonderful work considering the great number of applications which must be passed upon.

He put his finger at once upon a glaring injustice which is imposed by the laws of certain foreign countries upon inventors when they seek to protect their inventions abroad, in the requirement that in order to keep their patents alive during the term for which they are granted, the owners of those patents must "work" them, as it is called, and actually manufacture and put on sale in the country where their patents are granted, the devices embodying the patented invention within a certain limited period after the patents are granted. This means that factories must be built in those countries and the patented inventions actually fabricated there. In the United States patents are granted to everyone, citizens and foreigners alike, without any requirement that they shall manufacture and put their inventions in use in order that their patents shall remain in force for the term for which they are granted. He proposes to do everything possible to rectify this situation.

At the coming conference for the protection of industrial property to be held at The Hague in October, we venture to assert the opinion that when Mr. Hoover or his representative speaks, whatever may be said will be received with considerable interest, and we know that the case on behalf of American inventors will be adequately presented. Mr. Hoover is not a stranger to foreign governments and their representatives. They know him well and they know him to be one who in an emergency is willing to tackle a big undertaking and carry it through to a successful conclusion. They know what he has done in the World War—how he jumped in at the very beginning, raising funds and assisting our citizens who were caught in the maelstrom of war while on pleasure bent, to return to their own country, and afterwards how he took charge of the distribution of food sent over from the United States to save the starving civilians—and that finally when we entered the war he was called upon to conserve and direct the distribution and use of food in the United States, so that we not only could spare some for our hungry Allies but insure that the 2,000,000 soldiers which we sent abroad should be assured of sufficient.

Mr. Hoover before this was a successful mining engineer, a profession from which he was always assured of a lucrative return, and no doubt his natural inclination was to return thereto after he had accomplished the almost superhuman tasks which were confided to him during the war, but we find him answering the call of the late President Harding to head the comparatively new Department of Commerce, which under his direction has become a real and outstanding department of the government. It was a real sacrifice considering the meager compensation which the government pays to its cabinet officers, to say nothing of the tremendous burden of work involved, but the results accomplished by the Secretary of Commerce speak for themselves, and no doubt Mr. Hoover finds his true compensation in the thought that his fellow citizens appreciate what he has done. It would be impossible to get men like Herbert Hoover for the salary which the government provides if it were not that such men place the opportunity to do service to their fellow citizens far above any monetary consideration.

Again we say that the inventors of this country and the heads of industries based upon patent protection are to be congratulated that the Patent Office is now a part of the department headed by Herbert Hoover.

T. H. A.

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THE transfer of the Patent Office to the Department of Commerce recognizes that patents and trademarks are inseparably connected with business and commerce. Patented inventions are the basis for most of our industry, including both manufacturing and transportation. Trademarks play more and more an important part. Both center in the Patent Office whose activities, therefore, have a direct and important effect upon commercial life. The supervision of that office naturally belongs to the Department which Congress has charged with the duty of fostering and promoting commerce. The transfer to it has been recommended by all the commissions which have studied government reorganization, including Congressional and Senatorial Committees. It was strongly approved by both Secretary Work and myself and by the Commissioner of Patents, and was accomplished by the direct executive order of the President.

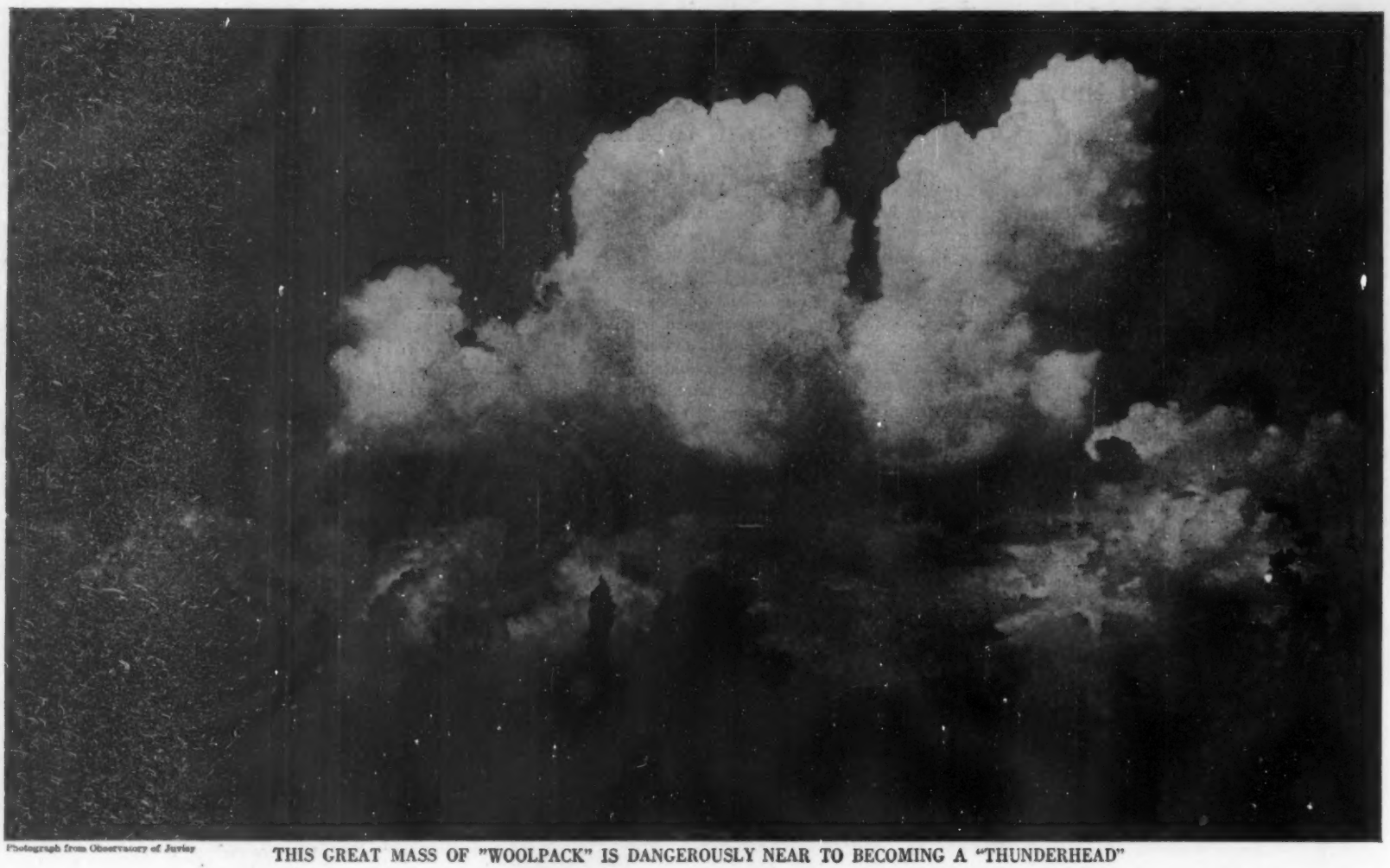
The office is functioning well, and while it is now behind in its work, due to insufficient personnel and the great increase in applications, it is rapidly catching up and will soon be to the point where applications will receive prompt disposition, and delays will be obviated. That is merely a matter of continuing efficiency so as to overcome congestion.

I have already called attention to the unfortunate position in which American inventors find themselves in protecting their patents in foreign countries. I hope that at the coming conference for the Protection of Industrial Property to be held at The Hague in October some remedy will be found. As the law stands today one of our citizens who has made a valuable discovery and who patents it abroad must actually manufacture it there within a stated time or lose his rights. This forces American manufacturers to construct works in those countries, with consequent immense loss to our own labor, exports and industry. The manufacturer abroad is in precisely the opposite position. He is not compelled to manufacture in the United States. He may make his product in his own land and export it here with the full benefit of our markets, while at the same time under his patent rights preventing anyone here from making the article, thus monopolizing the American field from abroad without fear of competition.

Copyright by Harris & Ewing

The primary function of the Patent Office is to stimulate and protect American ingenuity and inventiveness. The success of the system and the efficiency of its operation is demonstrated in the dominant place held by American genius in the inventive world. I hope to continue and to improve its effectiveness as an aid to American industry and assistance to American commerce, bringing it closer into touch with the activities which it was created to serve. No drastic reorganization is contemplated or necessary.

Herbert Hoover



Photograph from Observatory of Juvisy

THIS GREAT MASS OF "WOOLPACK" IS DANGEROUSLY NEAR TO BECOMING A "THUNDERHEAD"

# Vacation Meteorology and the Lure of Cloudland

*By Charles Fitzhugh Talman*

DOWN goes the roll top, or into the drawers of the flat top goes the unfinished work; for this is vacation time when business must stand aside for pleasure and the call of the great outdoors. You have been working for an entire year with the hope of a pleasant two weeks ahead of you all the time. After the "red top" puts you into your seat, or the steward into your stateroom and you begin to turn the pages of "Adventure" magazine, or a good detective story, you are apt to forget that something is going with you that can make or mar your vacation, and that is the weather.

Though we cannot control the weather, we can always make the best of it. Even the worst weather, as the immortal Shepherd of the "Noctes" tells us, "has aye some redeemin' quality about it." The pleasure of studying the clouds may help to console you for a scarcity of sunshine. Vacation time affords a good opportunity for this pursuit for the following reason: You usually take your outing at the seashore or in the mountains; in the former case you have a broad horizon, and in the latter you are lifted into cloudland itself and can get an intimate view of the things that happen there.

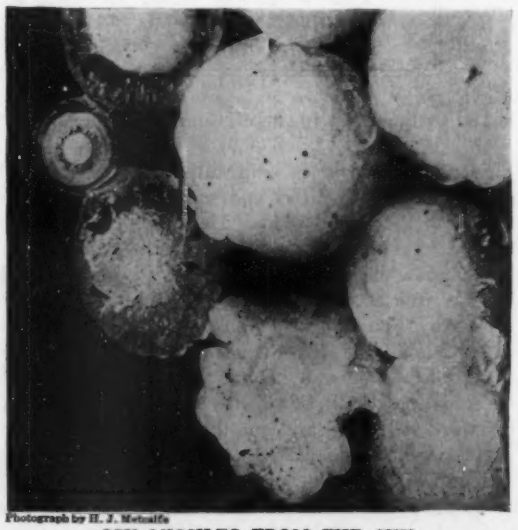
A cloud is, of course, born of the air; or rather of that element of the air which has more to do than any other with the making of weather, namely, invisible gaseous moisture, called "water vapor." For any given temperature there is a maximum amount of this substance that can be present, per unit volume, as a gas. When this limit is reached physicists say that the space (or the water vapor in it) is saturated, while the rest of the world is more likely to say that the *air* is saturated. The distinction is somewhat abstruse and we need not dwell upon it here. When (to dodge the verbal difficulty) saturation occurs, cooling of the air causes some of the moisture to condense in visible form—liquid or solid. The condensed moisture may be taken out of the air altogether, in the various species of "precipitation," including rain, snow, hail, dew, hoarfrost, and so on, or it may remain suspended for a time in the shape of water droplets or ice crystals, and then we have clouds or fog. A fog and a cloud are identical in structure, but usually different in their mode of origin. A fog is generally due to temperature conditions of the land or the water, while clouds, in the majority of cases, are produced through the cooling of air by expansion.

The meteorologist is not, as many people suppose, entirely occupied with the ticklish task of predicting the weather. He is much more versatile than that, and one occupation he is always ready for is to help you enjoy the pageantry of the atmosphere by telling you what to look for.

Photograph by L. C. Twyford

EXAMPLE OF MAMMATO-CUMULUS

*Clouds bulging downward as these do are so uncommon that they arouse much interest whenever they appear*



Photograph by H. J. Metcalfe

ICY MISSILES FROM THE SKY

*Large hailstones collected in Yorkshire, England. Some of them show clearly the alternating layers of ice and snow*

Photograph by Miss M. R. Corts

WATERSPOUT ON LAKE ERIE

*Good photographs of waterspouts are unaccountably rare in scientific collections. Photographers who secure such pictures should send prints of these to the United States Weather Bureau in Washington, D. C.*

Now, to get down (or rather up) to the clouds. You see, for example, a vast mass of "woolpack," or cumulus cloud which, on a hot summer's afternoon, towers higher and higher, with a smoothly rounded summit. A delicate, filmy veil may be seen forming at the top of the cloud. This is the so-called scarf cloud, usually cap-shaped at first, with the convex side upward. Later on the cap spreads into a broad mantle, which may eventually become a collar, as the main cloud rises through it. The appearance of the scarf is one of the signs that the cumulus cloud is changing to a cumulo-nimbus, or thundercloud. A still more positive sign is the spreading out of the summit so that the whole cloud seen in profile has the form of an anvil.

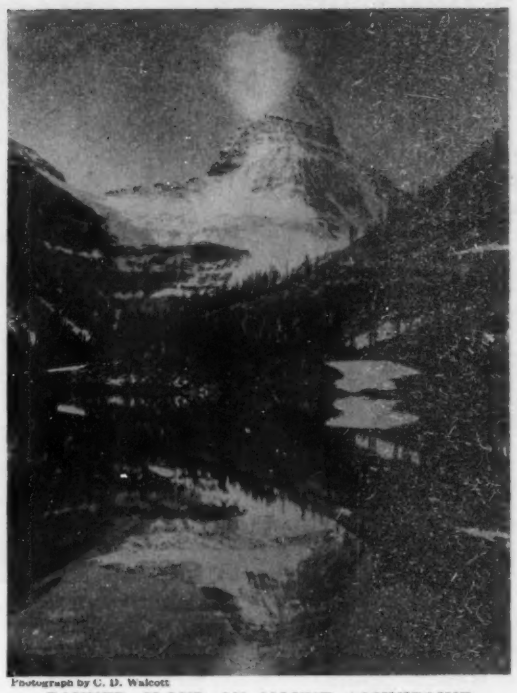
One of the splendid sights of nature is the formation of a great thundercloud. In our latitudes, such clouds are often more than four miles deep from the base to the summit, and, in the tropics, eight or ten miles deep. In area they may spread over many miles of country. The moisture made visible in them is condensed from millions of tons of air that stream up, in some cases, at the rate of half a mile a minute. It is thought that the breaking up of water drops into fine spray by these upward blasts of air brings about a separation of positive and negative electricity on a vast scale, thus producing the enormous voltages of the thunderstorm.

Thunderstorms have their descending, as well as their ascending currents. In some places there may be merely a settling down of the air; but at others there are violent down-rushes often found by aviators when they attempt to climb above a thunderstorm. The occurrence of these downward movements of cool air probably explains the occasional appearance in thundery weather of numerous sack-like protuberances from the base of a cloud layer. Meteorologists call this formation mammato-cumulus.

Hailstones furnish more evidence of the up-and-down movements of the air in the thundercloud. True hail (as distinguished from certain hail-like forms of precipitation that occur during cold weather) falls only during thunderstorms, or closely related atmospheric disturbances. When large hailstones are broken they are nearly always seen to consist of several layers of alternate ice and snow arranged like the skins of an onion. This is interesting as showing that during their formation they traveled back and forth between the cold regions aloft, where they were coated with snow, and the warmer regions below, where they received deposits of water which turned to ice during subsequent ascents.

You learn the names of common birds and flowers, so why not add the names of the clouds to your stock of nature study lore? Some clouds easily fall into well defined classes; but others are on the border line. The International Cloud Classification, used by meteorologists, is set forth in a little book issued by the Weather Bureau, and sold by the Superintendent of Public Documents, Washington, D. C., for twenty-five cents. The book is called "Cloud Forms According to the International System of Classification."

One interesting type of cloud that has only lately attracted much attention on the part of meteorologists is known as the "lenticular" cloud. Its usual form is that of a double-convex lens (seen edgewise), and it will often be found to consist of a number of separate cloudlets. The whole cloud has a pearly lustre and its thin edges frequently show iridescence. Sometimes the cloud bank thins away from the forward edge to clear sky within, so that the shape becomes that of a horseshoe. Unlike most clouds, the lenticular cloud does not drift with the wind, but is in constant process of formation on the windward side and of dissolution on the leeward.



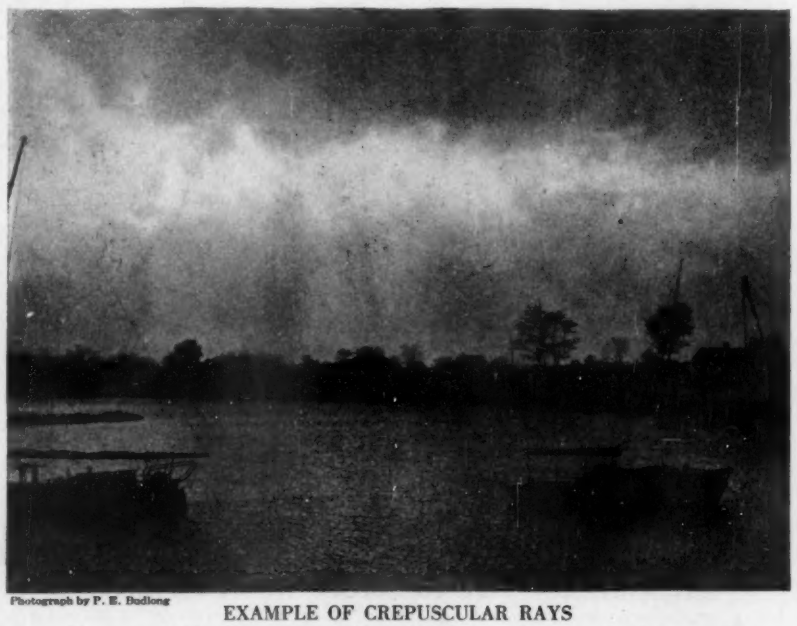
Photograph by C. D. Walcott

BANNER CLOUD ON MOUNT ASSINIBOINE

*In strong wind the pressure to the immediate leeward of such a peak is reduced, and the resulting low temperature, intensified, perhaps, by the mountain surface, appears to be the cause of this singular cloud*

Nearly related to the lenticular cloud are the cloud crests, caps and banners often seen in actual contact with peaks and ridges. These were once known as "parasitic clouds," and were a subject of much curious speculation a century or more ago. At a later period Ruskin devoted a good deal of unfruitful attention to them in his "Modern Painters." The usual cause of such clouds is that the air is forced to ascend in flowing over an obstruction and cools by expansion with the result that the condensation of moisture takes place.

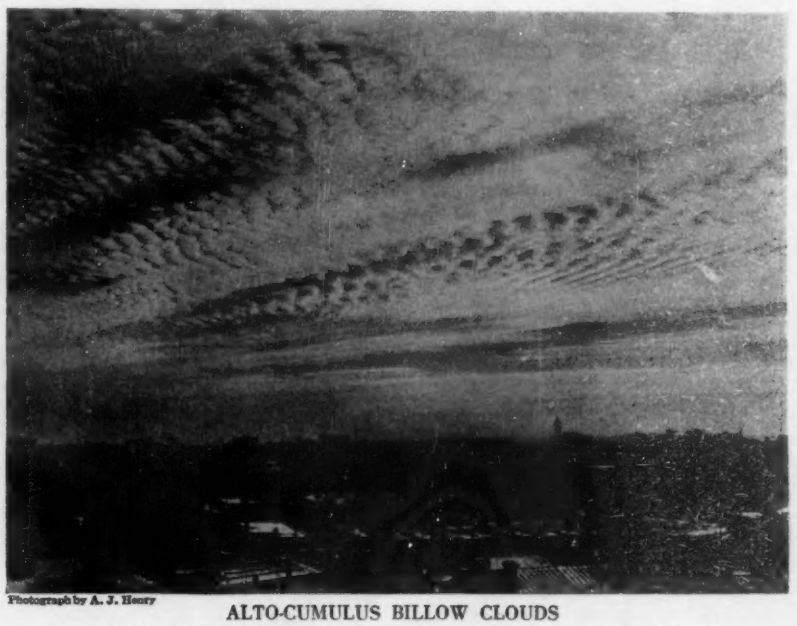
In the case of the cloud banners that stream from mountain peaks other factors enter into the process; namely, the reduction of atmospheric pressure in the immediate lee of the peak and the cooling of the air by contact with the peak. Lastly, there are "snow banners," such as those of the California mountains described by John Muir, in which the banners consist partly or wholly of snow blown from the summits.



Photograph by P. E. Dudlong

EXAMPLE OF CREPUSCULAR RAYS

*Shown in the familiar form popularly described as "the sun drawing water."*



Photograph by A. J. Henry

ALTO-CUMULUS BILLOW CLOUDS

*In this photograph two wave systems are shown crossing each other*

Photograph from Observatory of Trappes

THE ANVIL OF THE THUNDERCLOUD

*The summit is combed by the winds into fibres of so-called "false cirrus" or "tonitro-cirrus"*

Photograph from Observatory of Trappes

CALLED BY THE GERMANS "FALLSTREIFEN"

*These cirrus-like streaks dangling from clumps of alto-cumulus lack an English name*

While lenticular clouds and mountain cloud caps are due to standing atmospheric waves and, therefore, have little or no progressive motion, there are many types of cloud formed by waves of other kinds in the atmosphere that travel across the sky. The commonest of these arise from a process that an English cloud specialist named "interfret." One of the clearest explanations is that given by G. A. Clarke in his book on clouds. He says:

"The beautifully waved structure seen in nearly all of the layer-type of clouds, from cirrus down to strato-cumulus, is caused by the propagation upwards or downwards of the wave motion that is produced by the flowing of air currents of different velocities and directions over each other. Exactly similar patterns are formed by water currents rippling over sand, by the wind rippling the surface of the æolian sand dunes, and also by the wind on the surface of drifted snow." The same writer also explains why these clouds do not necessarily form just at the boundary plane between the two air currents, but often far above it or below it.

Many of the most striking cloud effects are due to perspective. Thus, it is not unusual to see long strips of cirrus or other high clouds apparently radiating like the spokes of a wheel from some point on the horizon, or from two opposite points in case they stretch entirely across the sky. These strips often stream outward from a storm center and, hence, gradually diverge, but they are so nearly parallel at any one point of observation that their apparent divergence is almost entirely a perspective effect.

Curiously enough, most formal cloud classifications and even books on clouds completely ignore the most remarkable cloud known to meteorology; namely, the so-called "funnel-cloud" of the tornado and the waterspout. This cloud often departs quite widely from the funnel form, and its different varieties have been photographed too seldom.

Even more fascinating than the study of clouds is that of the optical phenomena of the atmosphere. The diversity of these phenomena is far greater than most people suppose. The rainbow, for example, varies considerably in its colors and in the breadth of the luminous band, according to the prevailing size of the rain drops by which it is formed. Large drops produce narrow bows, showing the most distinct and vivid colors, while at the opposite extreme we have the broad and almost colorless bow formed by the minute drops of a fog.

One common feature of the rainbow is so unfamiliar that descriptions of it are occasionally sent to scientific journals by people who fancy they have discovered a previously unknown phenomenon. This is the repetition of the rainbow colors one or more times along the inner edge of the primary bow and sometimes along the outer edge of the secondary, constituting what are called "supernumerary" rainbows. The reflection of the sun upon a sheet of water may give rise to both primary and secondary rainbows, which, on account of the low angular position of the source of light, are larger arcs than semicircles and intersect the bows formed by the sun directly at the same time. The resulting quadruple rainbow is a rare and striking spectacle.

Fleecy water clouds often form the "tender amber round" encircling the sun or moon, technically called a corona. On account of the dazzling brightness of the sun, its corona is not easy to observe without the aid of tinted glasses, but the lunar corona is one of the commonest of sights. The corona is formed by diffraction. The larger the drops in the cloud the smaller the ring, and *vice versa*.

Of course "vacation meteorology" can be studied at any time of the year, and without putting one's nose out of doors. There are excellent books on meteorology to help you enjoy a vacation anywhere under the open sky.

Photograph from Observatory of Trappes

ONE OF THE MANIFOLD TYPES OF CIRRUS

*Classifying the different varieties of cirrus is a favorite pursuit of cloud specialists. The form shown above approaches cirro-stratus*

Photograph by G. A. Clarke

PRIMARY, SECONDARY AND SUPERNUMERARY RAINBOWS

*The supernumeraries, conspicuous in this picture along the inner border of the primary, though not uncommon, escape the attention of the vast majority of people*

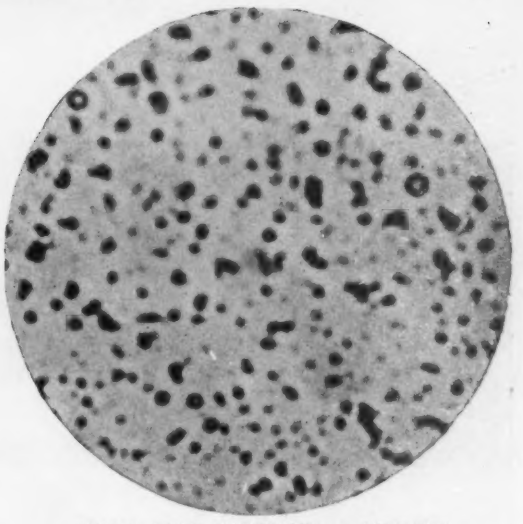
# Analyzing a "Pea Souper"

## How the Meteorological Office Studies London Fog

Photopress

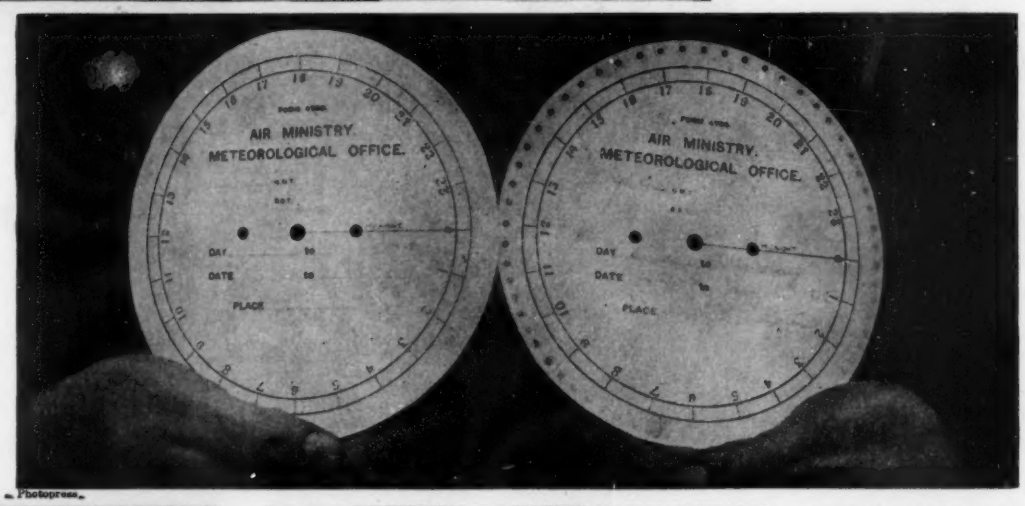
**TAKING SAMPLES**

*Dr. J. S. Owen (in the photograph above) getting a sample of fog from his office window with an instrument of his own invention*



**516,000 SOOT PARTICLES A MINUTE**

*This is for a square inch. The average diameter of a particle is 1-25000 of an inch*

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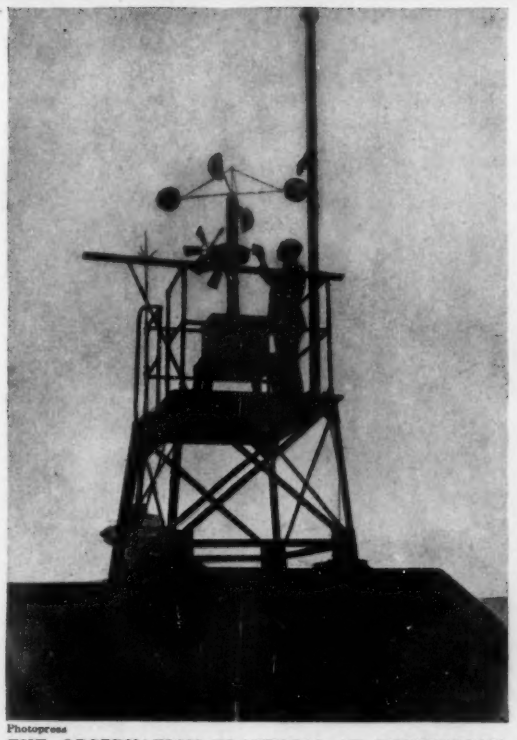
**RECORD OF FOG**

*The card record obtained by the instrument is shown at the left. The ring of dirt spots on the edge of the blotting-paper disks indicate how the fog increased in density toward midnight, lifted slightly in the morning and gradually thickened again during the day*

Photopress

**MEASURING FOG AT KENSINGTON**

*Air is drawn through a tube by suction. Density of fog is indicated by dirt deposited*



Photopress

**THE OBSERVATION PLATFORM AT KENSINGTON**

*Here observations of many kinds are made. The "Meteorological Office" corresponds to our Weather Bureau*

International Newsreel Photo

**THE SOOT GAGE**

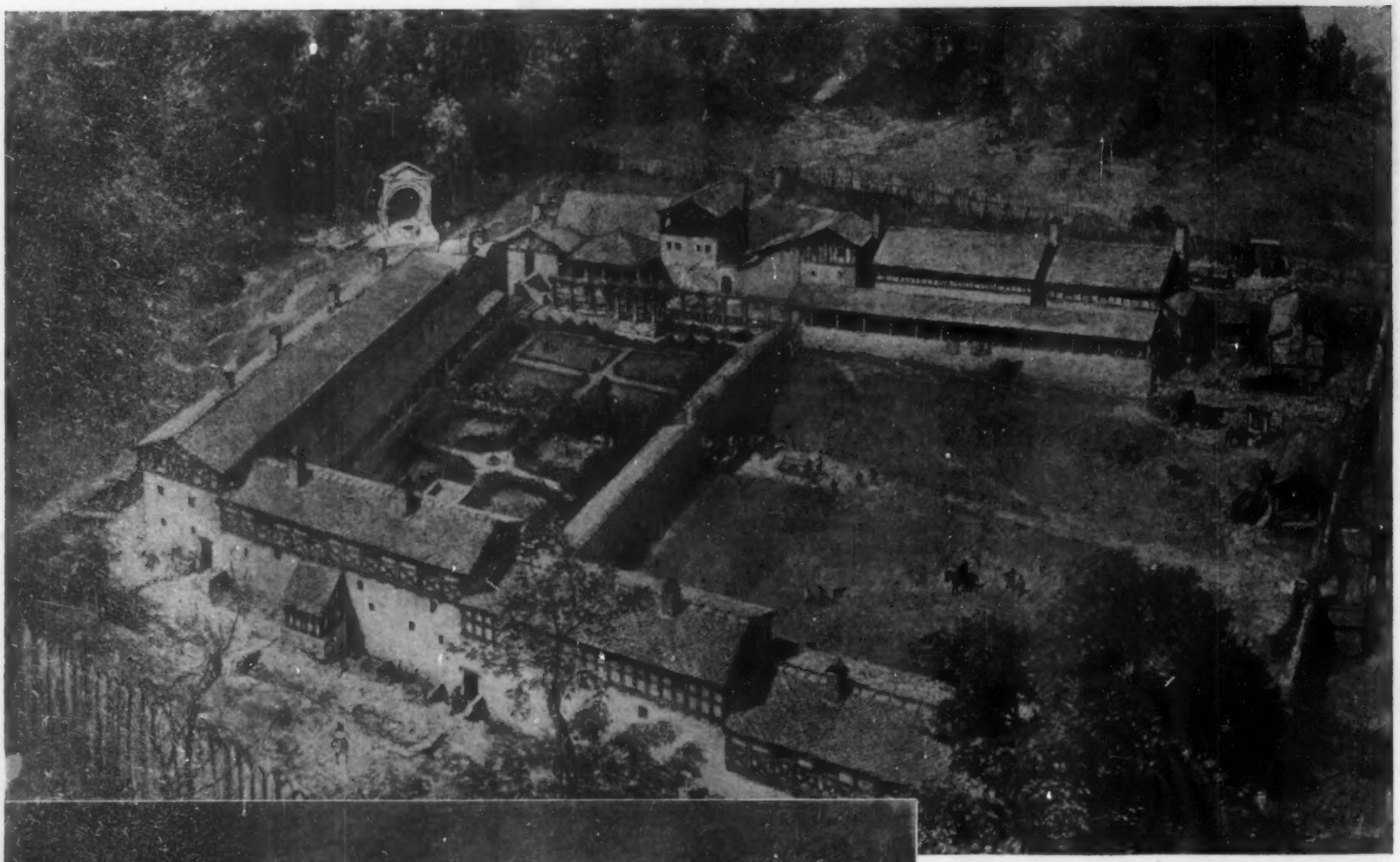
*A soot gage on the roof receives deposits in a basin. Rain carries these down through a tube into the bottle below*

# The Roman Villa at Chedworth

## Found in Hunting a Whining Ferret

Reconstruction drawings by A. Forestier in "The Illustrated London News"

Photographs by Moss, Cirencester



### ROMAN COUNTRY LIFE

Above: *A home and hunting box at Chedworth near Cheltenham in the Cotswold Hills that is believed to have become a factory for fulling and dyeing. A ferret whining among the labyrinthine rabbit-runs beneath an unknown Roman British pavement caused the spade to be sent for and presently it threw up shoals of colored cubes from a mosaic floor that had felt no foot pressure for fifteen hundred years. The villa dates from the Fourth Century (A.D.). It has now been taken over on behalf of the nation. Our beautiful picture is from a reconstruction drawing by A. Forestier*

### FULLERS AT WORK

At the left: *It is believed that the villa in time became, in part at least, a factory for dyeing and fulling, the factory portion being on the north side. If we begin to consider fulling and dyeing operations, the necessary processes of drying, stretching, bleaching, combing and pressing we will see that considerable space is required. Evidently pure water and a deposit of fuller's-earth made this an advantageous place to manufacture. This wing of the villa shows every indication of its being put to special uses*

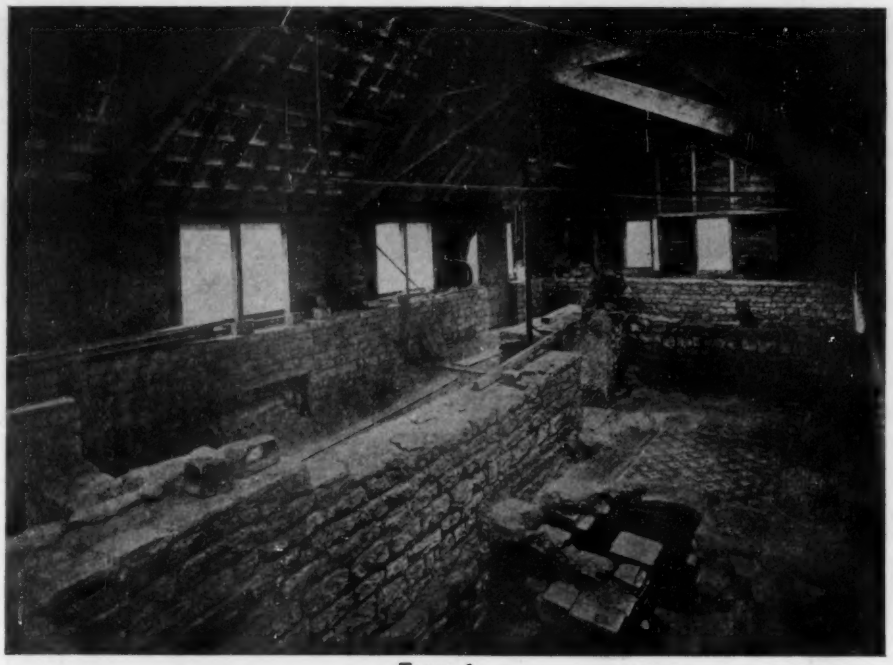


FIGURE 1

PART OF THE ROMAN BATHS

FIGURE 1: *The Romans carried the ideas of their baths to the countries they conquered so that it is natural that an important settlement such as existed must have had baths. The picture shows (left) the entrance to the cold plunge and the pavement of the "very hot" chamber (right). Note the tesselated floor*

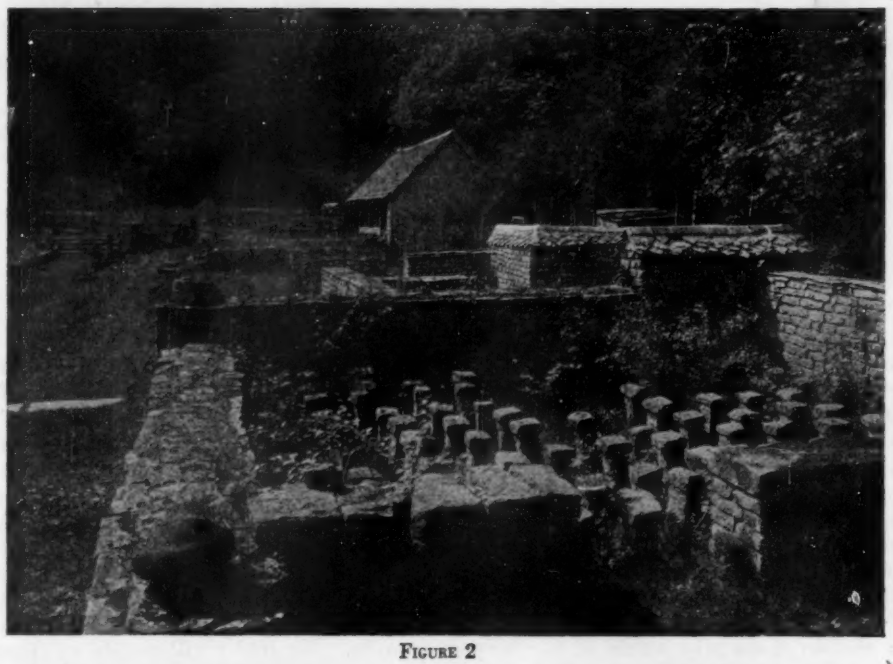


FIGURE 2

SUPPORTING A HEAVY DUTY FLOOR

FIGURE 2: *Small monoliths supported a floor which was undoubtedly subjected to great pressure. This was a part of the industrialized north wing of the villa in which it is believed, free and serf labor carried on fulling and dyeing on a large scale*

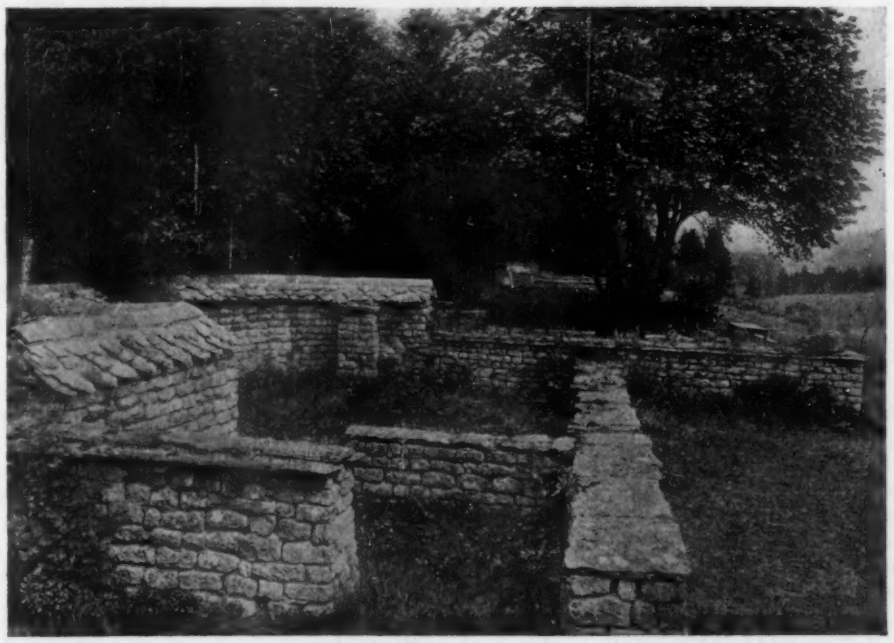


FIGURE 3

PART OF THE FOURTH CENTURY FACTORY

FIGURE 3: *The north wing was pre-eminently the commercialized portion of the buildings. Dyeing operations require more or less heat and the arrangements at Chedworth were admirable. Many of the vats are in almost perfect condition. Probably the great green was used for bleaching purposes*

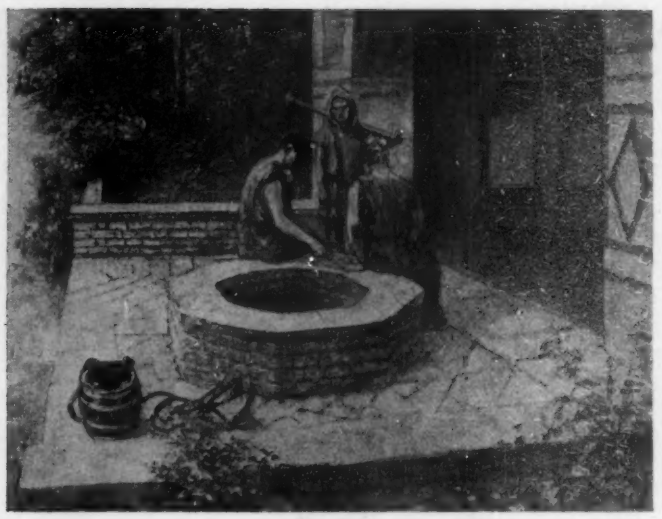


FIGURE 4

A GAME ON A STONE CHECKER BOARD

FIGURE 4: *The well over a reservoir will be noted outside the villa. Here a checker board was cut into the stone and the drawers of water and the hewers of wood met in the idle hour to play a game as shown by Mr. Forestier in his admirable reconstruction drawing*

COUNTRY PLEASURES IN THE FOURTH CENTURY

FIGURE 5: *When the evening meal was over the happy occupants sat on the terrace which was located in front of the dining room. The shed with ill-smelling tanks in the rear must have taken away some of the pleasure*

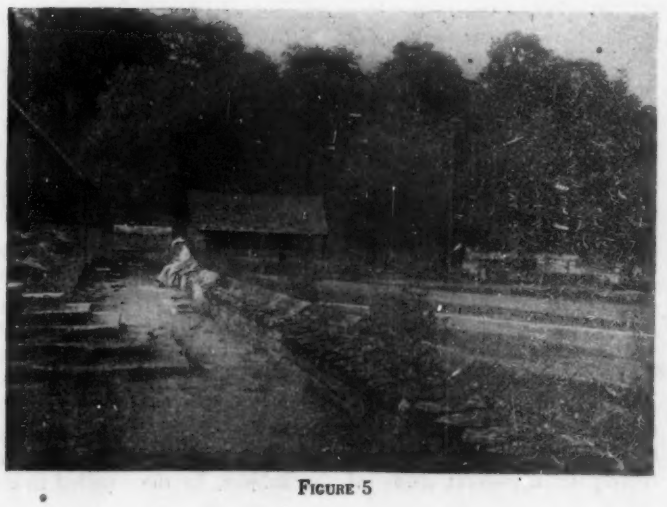
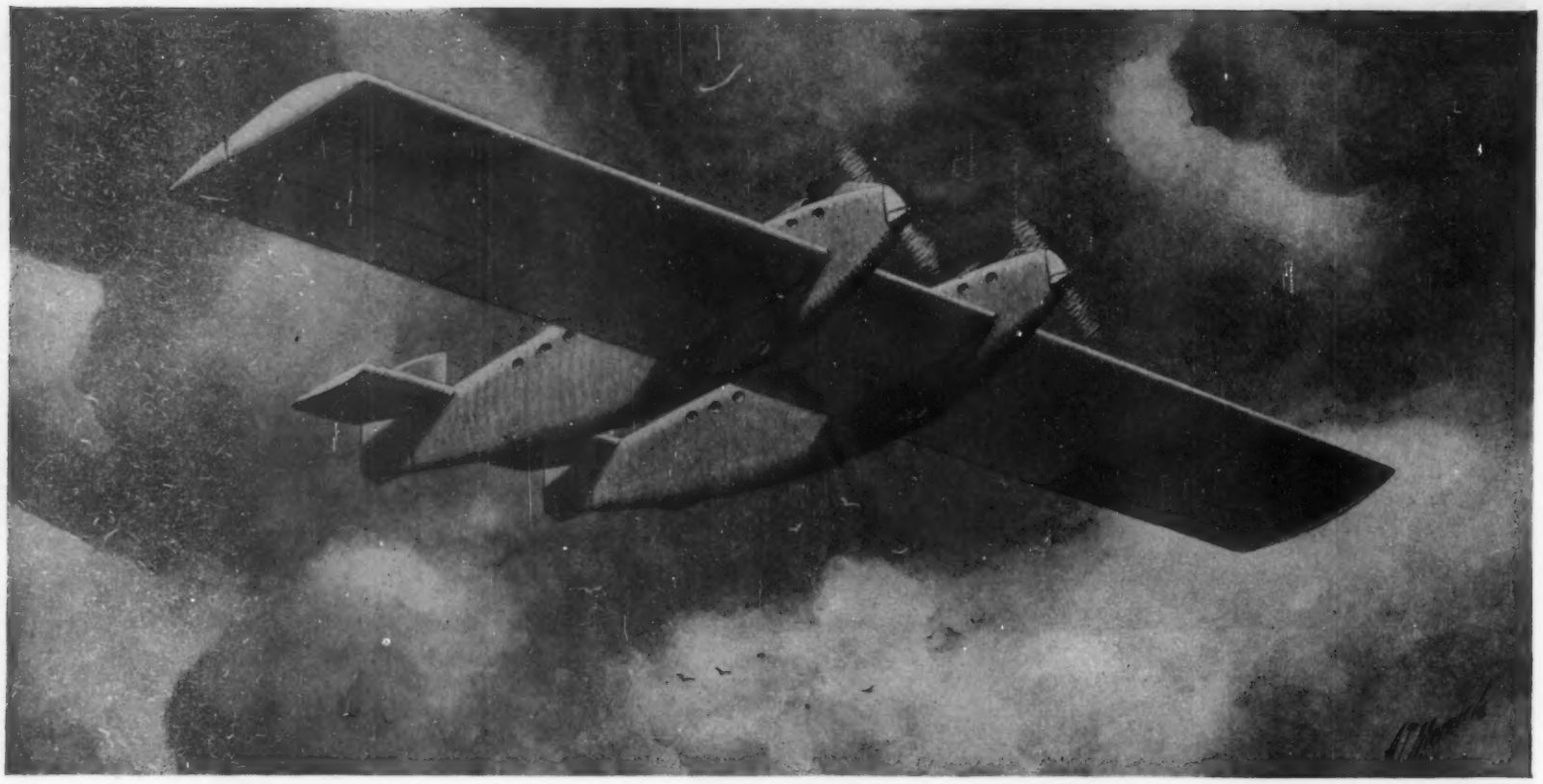


FIGURE 5



# The Low-Resistance Airplane

## The Technical Essentials of Commercially Profitable Aviation

*By J. Bernard Walker*

THE first public exhibitions of competitive airplane flight took place in 1910, at Boston and at the Belmont Park Meet, the latter being held at the racetrack of that name. The most successful flying machines of Europe and America were present, and for six days the public had an opportunity to study the very latest designs and witness the utmost possibilities of flight of the airplane of that day, now some fourteen years removed.

The writer, who was present at the Belmont Park Meet, visited every hangar, and, after a careful inspection of the various machines, came to the conclusion that, before any great addition could be made to the then highest speed, which was about sixty miles an hour, it would be necessary to pay attention to an element in aerodynamics which, in the machines as they then existed, seemed to have been almost totally neglected. He realized that the greatest defect consisted in the large amount of what is now known as "parasite resistance." In other words, the airplane of 1910 presented, with its mass of braces, trusses, wires and deep and cumbersome landing gear, an amount of end-on air resistance which was fatal to the realization of any degree of high speed.

### Early Airplane a Veritable Birdcage

Those of us who can call to mind those early days will remember that the average airplane was a veritable birdcage in the multitude and complexity of its parts. So, in thinking the matter over, the writer sketched out an airplane, in which an endeavor was made to cut down all needless air-resisting members and reduce the machine to something of the sweetness of form of the fastest flying birds. This sketch and its accompanying article were published, merely as a general study of the subject, in the Scientific American of October 22, 1910, and the story was reprinted in our issue of August 14, 1920. In the reprint we spoke of the design of 1910 as a "loose study of a problem to which the engineering profession of that day was about to apply itself." The results of that study were to be revealed a few years later on the battlefields of France and in the memorable flights across the Atlantic. "The present-day interest (1910) of this article," we said, "will be found in its fruitful anticipation of subsequent developments as seen in the oval, stream-lined nacelle and the sheltered position of the pilot within it; in the substitution of interior metal wing beams for exterior ties and struts; in the retractable or folding chassis; the gyro control of the ailerons; and the use of alloy metal throughout, with corrugated covering for the wings." After a lapse of eight years there was produced, in the summer of 1918, the Junker all-metal war monoplane, with internally braced wings covered with corrugated metal. In 1920 the retractable chassis as suggested in 1910 was being made the subject of experimental effort.

In recent years, the work of refining the airplane with a view to cutting down parasite resistances has been steadily prosecuted, and in the present article we present a late design by James V. Martin, in which the problem of reducing end-on or head resistance, as suggested fourteen years ago, has been carried apparently to the full limit of its possibilities. It should be noted further that the machine has been equipped with the bi-convex wing which is so largely responsible for the sensational speeds of some recent racing machines.

The following description is based upon notes furnished to us by the designer. Our line drawing on the adjoining page shows an efficient, bi-convex, aerofoil in cross-section. If such an aerofoil be propelled in a direction from "B" to "A" at high speed the amount of propeller thrust required to propel it may be as little as one-twentieth of the amount of force along the vertical line which is marked "lift." In other words, for every pound of propeller thrust expended in driving the aerofoil forward twenty or more pounds of "lift" are obtained. The line marked "drag" at the top of the diagram represents the amount and direction of the air resistance which the propeller must overcome, while the adjoining vertical dotted line marked "lift" represents that component of the whole force which is available to overcome gravity. The reader will readily see from this diagram that the "lift" of a wing may bear a surprisingly large ratio to the drag. In most of the planes of today the "lift" and "drag" relationship does not work out so advantageously; for instead of obtaining twenty or more pounds of weight-carrying capacity for one pound expended in propeller thrust there is obtained from six to ten pounds of lift in conventional airplanes design and about six of these ten pounds are required to lift the weight of the structural parts of the airplane itself and the fuel required to drive it. Hence, a comparatively small amount of lifting capacity remains for the *pay-load*.

### Commercial Airplane Must Have Large Pay-load

Needless to say the pay-load is vital to the success of a commercial airplane. Therefore, the direct road to the production of an airplane that will pay commercially will be found in correcting a condition which causes the majority of our present type airplanes to have only a moderate lift over drag ratio.

Most of the conventional airplanes of today have a poor "lift-drag" ratio varying from six to ten at normal maximum speed. By correcting this inefficiency until a high "lift-drag" ratio is produced of

one to twenty, which laboratory tests show to be reasonable for airplanes of the type which is here shown and described, a paying airplane service becomes practicable.

The objectionable feature of the conventional airplane, from the standpoint of efficiency, is the amount and disposition of the parasite resistance, so called because it consumes the power of the motor without giving any lift whatever. Parasite resistance may be grouped under four classes: first, that of the body or fuselage; second, that of the wing trusses such as the struts and wires between the upper and lower biplane wings; and third, that of the airplane chassis, consisting of the wheels and chassis frame which support the fuselage while it is standing or running over the ground. A fourth classification includes various external wires, brackets and leads.

### Enemies of Speed and Load Capacity

The above are the enemies of airplane speed, flying, endurance and useful load capacity. Our drawing below roughly represents the "drag" on one of the aerodynamically useless parts of an airplane, that is on one of the landing wheels; all the resistance of which represents a dead loss of fuel and engine power. This useless consumption of power, however, is not the only detrimental effect of parasite resistance, since each one of these structural parts of an airplane obstructs the air flow for a considerable distance around it. It is a fact that even some distance in front of a body when rapidly driven through the atmosphere the disturbance begins. This is crudely represented by the diverging lines preceding the wheel, as shown in the drawing. The effect of this resistance, and of others of a like character, in a typical airplane of today, is that a mass of interference is built up about the wings which prevents their functioning as they should. Interference is the technical term used to describe the effect of one body or shape on another juxtaposed body in motion through the atmosphere. If we could eliminate the useless resistance and constant interference of airplanes, we should be well on the road to perfection and toward a means of transportation safer and cheaper than any hitherto known to man.

Not only is the study of modern aerodynamics teaching us to get rid of the parasite resistance described above, but it is also leading us to a great refinement of the shape or form of the aerofoil or wing. Flat surfaces are practically inoperable, owing to their poor "lift-drag" ratio; although it is possible, given plenty of power, to "plane" a flat surface through the air.

After learning the first lesson of the value of the upward curve, early experimenters labored for many years under the supposition that not only the upper but also the lower surface of the wing should be upwardly curved. Even the famous Dr. Junkers, who in 1911 indulged in the conception of a downwardly-curved wing portion in the wing center, when he decided to thicken the wing for the reception of passengers, motor, etc., hastened to say that this was done at a sacrifice to efficiency and that the wing should quickly taper into thin sections of the normal type. The bi-convex wing shown herewith has been demonstrated as highly suitable for high-speed flight. Recently there has been an increase in the use of the bi-convex frame or wing, until in the recent Curtiss racer, which made two hundred and sixty-six miles an hour, excessive speed was conceded to be impossible except by the use of the convex lower as well as upper wing surface. The world's most efficient speed aerofoil, listed as such in the latest National Advisory Committee's Report No. 182, is of this class of aerofoil, with each ordinate of the lower curves a fraction of the corresponding upper ordinate.

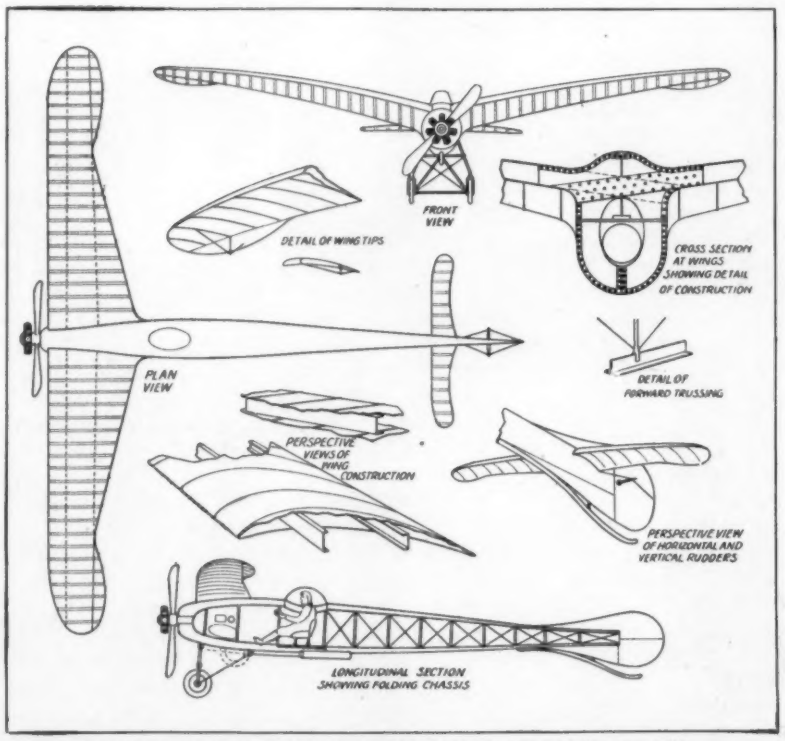
From what has been said, we are prepared to understand why the conventional airplane, with its low "lift-drag" ratio has been too inefficient to inaugurate on a widely extended and successful scale a system of successful airplane transportation. The large amount of parasite resistance presented by wires and struts of a biplane and by the fixed landing chassis protruding from the nacelle, to say nothing of the inefficiency of the existing form of wing has consumed so much of the available horsepower that the pay load has been cut down to a point at which profitable commercial aviation is scarcely possible except under very favorable conditions.

The bi-convex wing has the great advantage also that we can put the entire wing truss inside of the wing and thereby keep the drag of the wing at a minimum. The side and front elevations in the drawing show that the landing chassis may be retracted within the fin-shaped bodies during flight, and the relative size of these bodies to the wing has been so reduced that they offer practically no parasite resistance. The plane herewith shown, which is known as the MP I, is a medium-sized ship with three feet maximum wing thickness. In a later design, with an inner depth of six feet, accommodation for passengers will be provided within the wing itself. The flying performance estimates are computed from the Gottengen Laboratory test, without any scale allowance effect and, therefore, may well be below the usual full-scale performance. It is claimed by Mr. Martin for the machine presented, that it could carry forty passengers and five thousand pounds of freight in a non-stop flight from New York to Chicago in from five to six hours, depending upon the weather conditions.

### Airplane Travel Safest of All

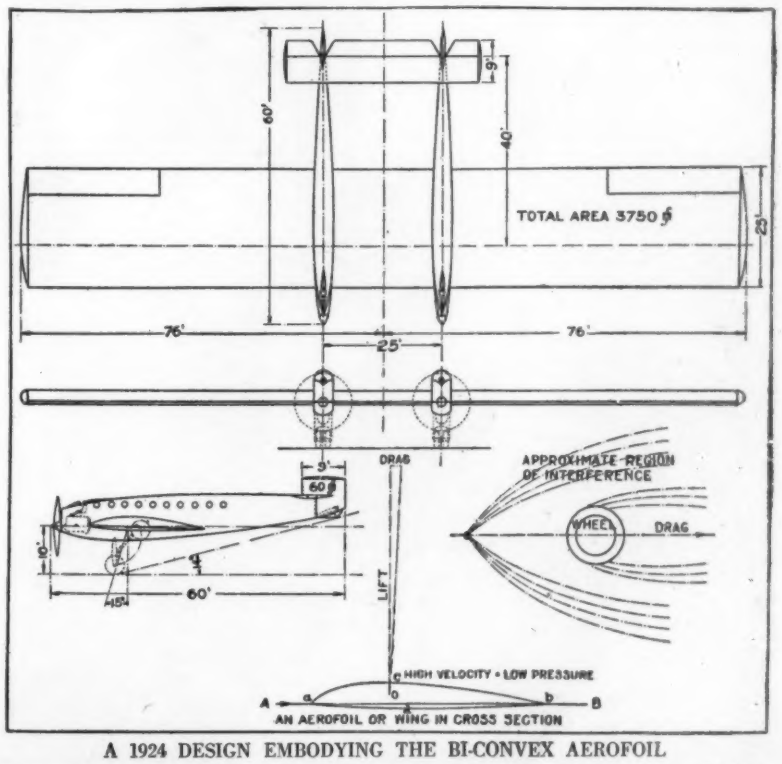
The designer of this plane believes that future air transport ultimately will be safer than any other means of travel, and much more comfortable. The machine here shown is provided with twin motors, in each of which there are three banks of six cylinders each, each bank driven through a clutch. Hence, should anything happen to a motor, the bank of cylinders having the trouble would be disengaged from the propeller drive, while the remaining banks continued to drive the airplane. This arrangement should practically eliminate the danger due to motor failure and guarantee continuous flight from flying field to flying field.

We have presented this design because of its extreme interest and its embodiment of the latest methods of meeting aerodynamical requirements. If the machine be built and tested it will no doubt attract the widest attention and interest of the aeronautical world. Claims for "lift" and for economy are high, but they seem to be based upon experimental demonstration and correct aerodynamic reasoning.




WALKER DESIGN FOR LOW-RESISTANCE AIRPLANE IN 1910

*This sketch, a dream of future development, first published in 1910, embodies the internally-trussed wing, with corrugated metal covering, the oval-section body and the folding chassis. The machine was to be built entirely of metal*




A 1924 DESIGN EMBODYING THE BI-CONVEX AEROFOIL

*The monoplane of 1924 marks the complete fulfillment of the dream of 1910. Parasite resistance is entirely eliminated, the wonderful bi-convex wing is utilized, and metal is used throughout*

# Making the Air Tell Tales on Itself

## Recently Perfected Devices Which Keep a Record of the Moisture in the Air

*By Paul B. Findley*

EVERYBODY knows that the oppressiveness of a hot day comes as much from the amount of moisture in the air as from the temperature itself. Our scrubwoman had the right idea when she once said, "It isn't the heat that bothers me over on Avenue A; it's the humanity."

There are other things besides tempers which are spoiled by humidity, or by the lack of it. A dry cigar is a poor smoke, while macaroni at one stage of its manufacture will fall to pieces if the humidity is not just right. Even the telephone is affected by moisture in the air. Water vapor, particularly when accompanied by gases and by floating dust, hastens oxidation and corrosion of metals. Also it reduces the perfection of electrical insulation given by various materials.

These effects are hastened by high temperatures and by electrical voltages. All are met with in telephone operation. Apparatus must be designed to withstand them. Accordingly the Bell Telephone Laboratories have carried out many investigations for the American Telephone and Telegraph Company on methods of measuring humidity, on the effects of various humidities upon telephone apparatus and on the design of apparatus which will be less sensitive to high humidity. The work of Mr. Edmund B. Wheeler, Mr. James C. Wright and their associates has resulted in several devices which are of interest to all who need an accurate knowledge of the moisture content of the air.

The air which we breathe is a mixture of several gases—nitrogen, oxygen, argon, carbon dioxide and water vapor. The water vapor is invisible, just as are the other gases. It obeys the same physical laws as they do. The amount of water vapor in the air varies, but it cannot exceed a certain maximum amount, which maximum rises and falls with the temperature. When this maximum amount is present the air is said to be "saturated." Usually less water vapor than this is present. The "percentage humidity" means the ratio of the amount actually present to the total maximum amount which might be present at that temperature.

Now when two substances, both containing water, are placed in contact, the one which is nearer saturation will give off water to the other. Leaf tobacco, for instance, will give off water to air of a certain humidity. Air of greater humidity will moisten the leaf. Hence in manufacturing tobacco, textiles, celluloid film, and many other substances the water content of which changes easily and which are partly dependent on their water content for their mechanical properties, close control of the moisture in the air is very important. This in turn requires accurate knowledge of the humidity, preferably by a mere glance at an instrument. A graphic record on a chart is also useful for supervision.

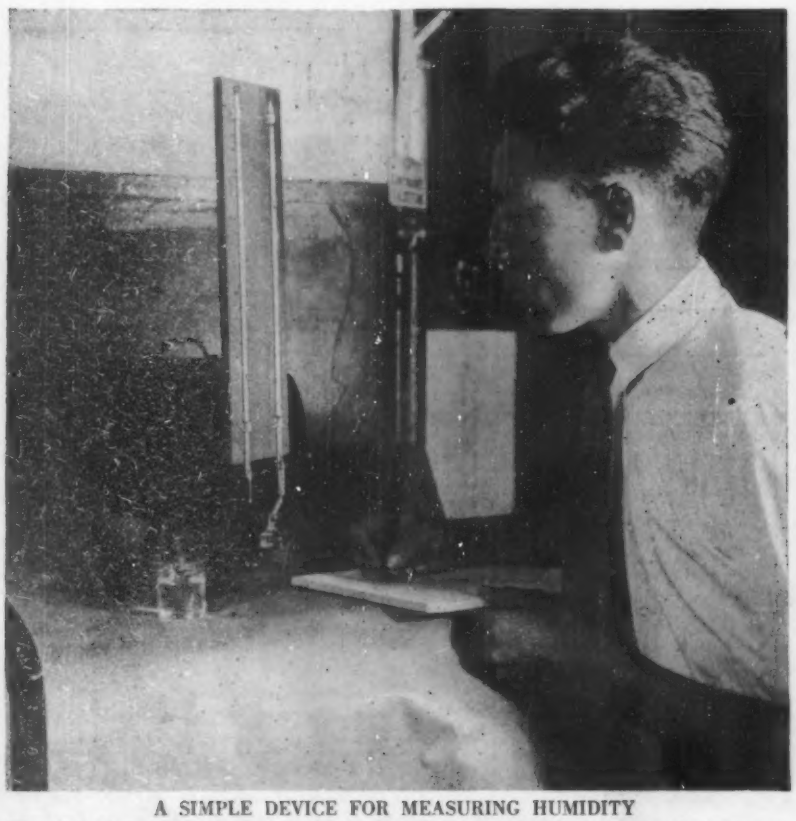
### How Fog Is Formed

Since the amount of water which the air can hold rises and falls with the temperature, it is evident that a lowering of the temperature may bring the air to a point where it cannot hold all the water contained in it. Immediately the excess water vapor will condense out as liquid water. This is how a fog is formed. When the air is chilled on a small scale, as by a glass of ice water on a summer's day, the water will form into tiny droplets on the outside of the glass or other cold object. The air temperature at which this condensation occurs is called the dew point. This dew point is determined by cooling a bright metal surface until a film of moisture just begins to appear and then measuring the temperature of the metal surface. Knowing this temperature and that of the surrounding air, it is possible to calculate the percentage humidity.

A readier method, and one followed by most observers, depends on the fact that the evaporation of water cools a wet surface. The temperature of a piece of wet cotton wicking, over which the air is circulating vigorously, will fall to a definite value. A thermometer enclosed in this wick will register what is called the "wet-bulb temperature." The temperature falls because the water must absorb heat in order to vaporize. Heat flows in from the wicking, from the thermometer bulb, and from the passing air-stream. Accordingly, the wet bulb will go to a temperature where there is a state of equilibrium between the heat used in the evaporation of the water from the wet bulb and the heat absorbed from the air.

This "wet-and-dry-bulb" method is the accepted procedure for humidity measurements. Mr. Wheeler's group decided that it might be made adaptable to some form of recording apparatus. The first step was to build a simple and practical mounting for the two thermometers. As shown in the illustration, this consists merely of a small wind-tunnel through which air is drawn by an electric fan. At the open end of the tunnel are mounted the thermometers; the bulb of one of them being enclosed in a cotton wick which dips into a bottle of water. Readings can be taken periodically. The humidity can be read from a chart and plotted on coordinate paper. This method is inexpensive and accurate. Where only occasional observations are to be made it is quite satisfactory.

But if data are to be taken over a considerable period some form of automatic recorder is desirable. Temperature records can be made on long, con-

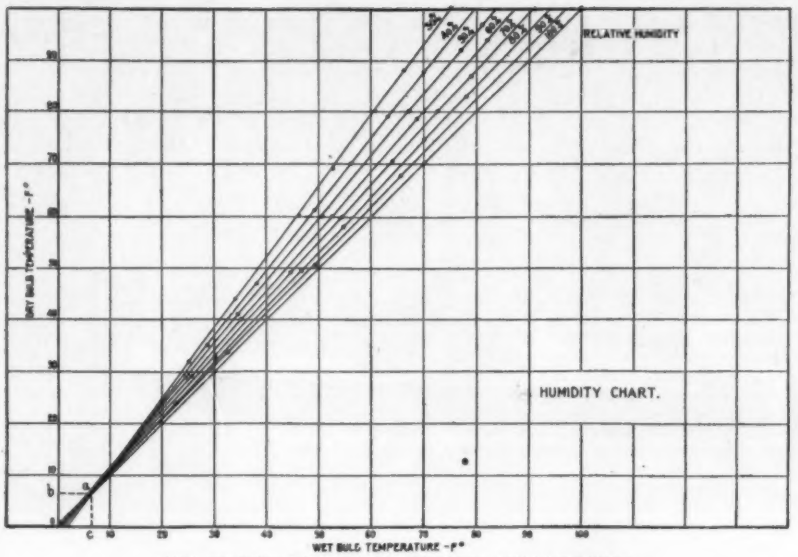


A SIMPLE DEVICE FOR MEASURING HUMIDITY

*The air is drawn through the small wind tunnel, past the bulbs of the two thermometers, one of which is kept wet while the other is dry*

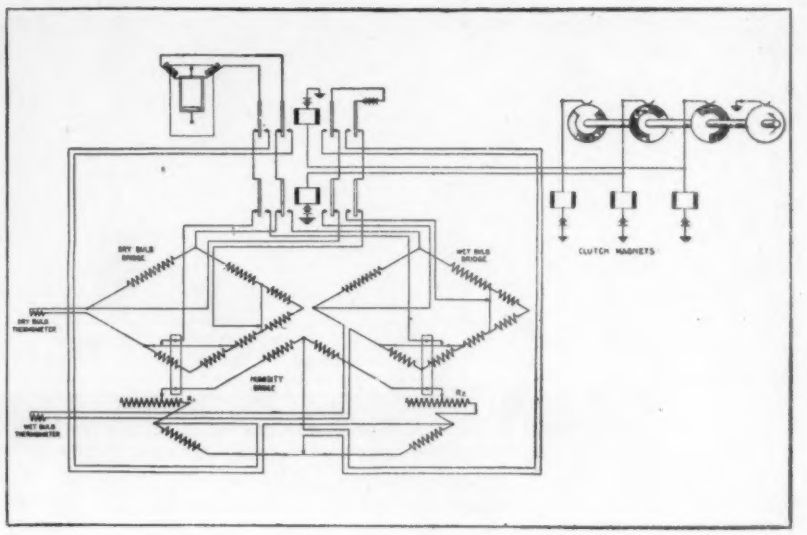
THE NEW DIRECT-READING HUMIDITY RECORDER

*The left-hand curve indicates the temperature of the air. The right-hand curve, to which Mr. Wood is pointing, indicates the degree of humidity*




THE CURVES WHICH SUGGESTED THE METHOD

*These curves show the relation between the temperature of a dry-bulb thermometer and a wet-bulb one, exposed to the same air. The lines indicate percentages of humidity*




DETAILED HOOK-UP FOR THE RECORDER

*This diagram shows the electrical connections of the three Wheatstone Bridge circuits which are used, in succession, to obtain the reading of relative humidity at a given moment*

tinuous charts by an electric recorder developed by Leeds and Northrup. It was felt that the technique of measuring temperature by the change of electrical resistance could be put to use here. The recorder measures the temperature by measuring automatically the resistance of a platinum wire, the resistance of which varies, of course, with the temperature.

Two such resistance units were made of platinum wire on mica cards and were encased in flat nickel-silver tubes with hard-rubber ferrules. Over one of these tubes a cotton wick was drawn, the other end dipping in a water tank. Both tubes were enclosed in slotted brass covers through which the air was drawn by a small motor-driven blower. Both resistances were connected to a Wheatstone bridge, through relays, so that two measurements were made alternately; namely, the resistance of the dry thermometer and the difference between the resistance of the dry thermometer and the wet one.

### Two Curves from One Pen

From these two measurements, one pen, by an ingenious arrangement, first placed a dot on the chart at a point which indicated the dry-bulb temperature and then another dot indicating the difference between the dry-bulb and the wet-bulb temperatures. By alternate plotting of these values two curves were drawn, one of dry-bulb temperature and the other of the difference between dry-bulb and wet-bulb temperatures. By reference to a standard psychrometric chart the values of relative humidity were later found and plotted.

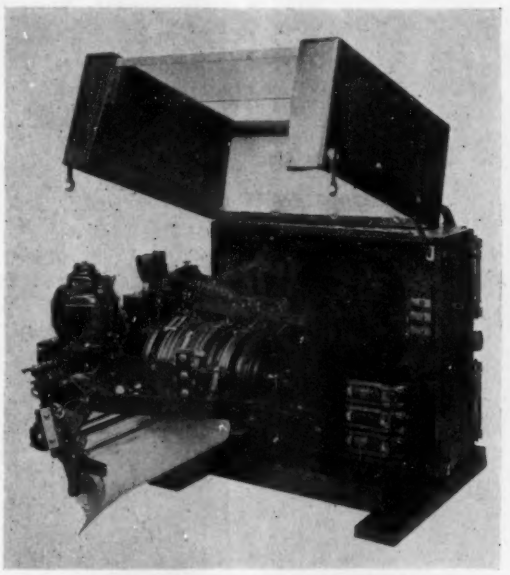
Several of these recorder mechanisms were built and, after having been adjusted to operate satisfactorily, each wind-tunnel equipment with its associated recorder was placed in a laboratory room controlled by air conditioning equipment and was given a run to test its operation under the range of conditions which might be expected to occur in practice. During this test, the readings given by the recorder were compared with those obtained with one of the small wind-tunnels carrying two mercury thermometers, as previously described.

It was appreciated all along that a more satisfactory recorder would be one which traces the relative humidity curve itself, instead of requiring that this curve be plotted from computed data. A particularly ingenious method of doing this has been developed by Mr. Ernest B. Wood, one of Mr. Wheeler's group. On plotting a group of humidity curves as shown on the chart reproduced herewith, Mr. Wood noticed that, within reasonable limits of accuracy, these curves are straight lines intersecting at a point a. If the coordinates of this point are called b and c, then the slope (the angle with the horizontal) of the humidity line passing through any point corresponding to a pair of wet-bulb and dry-bulb temperatures is given by the relation:

$$\frac{\text{dry-bulb temperature} - b}{\text{wet-bulb temperature} - c}$$

As will be seen from the curves, there is only one value of humidity which corresponds to a particular slope. Therefore, if we know the two terms of the above fraction, we know the humidity.

If we measure on one bridge the dry-bulb temperature and on a second bridge the wet-bulb temperature, we can take off, on one arm of a third bridge, a resistance proportional to the difference between the temperature of the dry-bulb and the temperature b, and on the second arm a resistance proportional to the difference between the temperature of the wet-bulb and the temperature c. When the bridge is balanced, the resistances of the two remaining arms will have the ratio of the fraction mentioned in the previous paragraph. In the particular set-up devised by Mr. Wood, the balancing is accomplished by moving a contact along a slide-wire and simultaneously moving a pen point across the chart. Since every position corresponds to a definite humidity the chart will read percentage humidity.



THE INSIDE OF THE RECORDER

*The slide-wires of the three bridges are on the edges of the disks at the left, these being operated, in succession, by the electric motor*

The complete recorder comprises three Wheatstone bridges with movable sliders, each of which may be connected to the driving shaft through an electrical clutch. The circuit is closed when the battery and galvanometer are connected to that particular bridge. Two other clutches are controlled by the galvanometer and drive the contact point in one direction or in the opposite direction until the galvanometer indicates a balance.

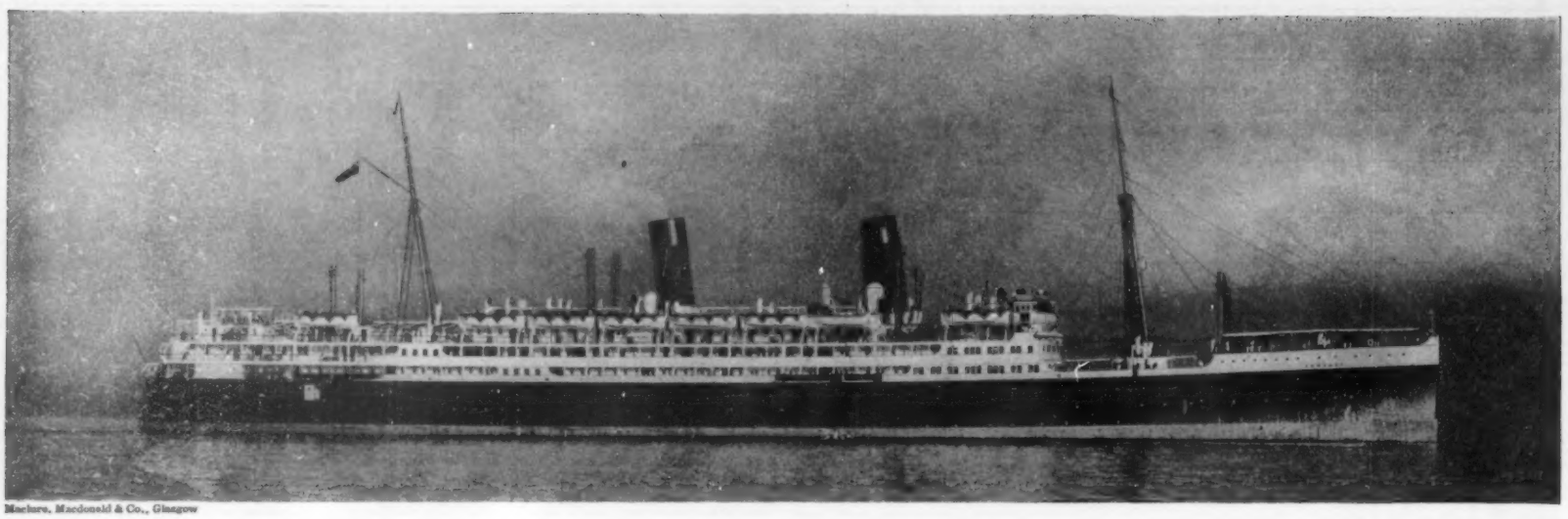
The first of these bridges, designated the "dry-bulb bridge" contains the dry-bulb resistance thermometer. Mechanically associated with its slide-wire contact is a second contact operating upon a slide-wire resistance arm in the third bridge. This is designated the "humidity bridge." The second of the bridges, designated as the "wet-bulb bridge," contains the wet-bulb resistance thermometer. Mechanically associated with its slide-wire contact is another contact operating upon the second slide-wire resistance arm of the humidity bridge.

### Three Electric Bridges Used

The consecutive balancing of the dry-bulb bridge and of the wet-bulb bridge accordingly sets off resistances upon the two resistance arms of the humidity bridge. These are proportional, respectively, to the temperatures described in the preceding paragraph. The balancing of this humidity bridge accordingly accomplishes the result already described of determining the ratio of the resistances of these two slide-wire arms. Consequently the bridge determines the relative humidity corresponding to the dry-bulb and wet-bulb temperatures, as previously measured on their corresponding bridges. In the automatic operation of the recorder, a period of about twenty seconds is allowed by the commutator for the balancing of each bridge, thus completing a cycle every sixty seconds.

The recorder is equipped with two pens, one of which is associated with the slide-wire of the dry-bulb bridge, thus recording the dry-bulb temperature, while the other pen is associated with the humidity bridge, thus recording the values of humidity directly.

While the mechanism of the direct reading recorder is more complicated than that of the difference recorder it is a more useful instrument. The humidities may be read directly, thus saving the labor of interpretation of the records. The direct reading recorder may be used, furthermore, to control the functioning of air conditioning apparatus at any desired conditions at the same time that it is actually recording these conditions.



Mackrow, Macdonald & Co., Glasgow

# New Motor Liner Aorangi

## This Eighteen-knot Vessel, 600 Feet Long, of 13,500 Horsepower, Is the Largest Motor Ship Afloat

THE Aorangi, recently completed by the Fairfield Company, Govace, Scotland, for the Union Steamship Company of New Zealand, carries the distinction of being the largest motor ship afloat, her total shaft horsepower of 13,500 being double that of any other motor-propelled vessel. She is 600 feet long, with a gross tonnage of 17,500, and she carries 440 first-class, 330 second and 230 third-class passengers at a sea speed of about eighteen knots. Her motive power consists of four six-cylinder, two-stroke, single-acting motors of the Fairfield-Sulzer type, driving four shafts. The cylinders are 27½ inches in diameter by 39-inch stroke and the normal piston speed is 825 feet per minute at 127 revolutions per minute. The total shaft horsepower is 13,500 and the total indicated horsepower is 17,000.

The Aorangi, as her photograph shows, is a handsome vessel with cruiser stern. The spacing of her two pole masts and two funnels is pleasing and helps to give her an undeniably smart appearance. The machinery occupies the center of the ship and the aft funnel houses the four exhaust pipes of the main engines. Forward of the main engine room is the auxiliary engine room and the forward funnel accommodates the exhaust pipes of four auxiliary engines and the uptakes from the boilers and ventilating trunks. The ship carries sufficient oil for a round trip from Vancouver by way of New Zealand to Sydney, Australia, and back, a distance of over 15,000 nautical miles.

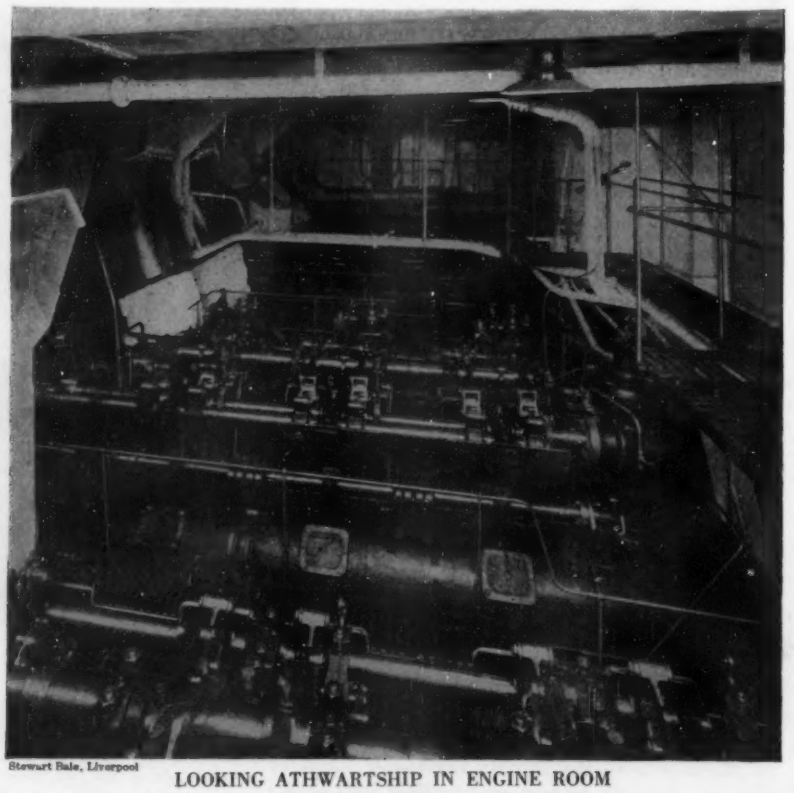
The trials of the ship included an endurance test of over sixty hours' operation, during which she made eighteen knots, and the absence of vibration was noticeable, the machinery, in spite of its great size and power, running with remarkable smoothness, thus setting at rest the fear that when motor machinery ran to large sizes its operation would be attended with unbearable vibration.

During the sea trials, lasting over a week, there was a 60-hour trial during part of which time heavy weather was encountered, and we are informed that both the engines and the ship gave an excellent account of themselves. The fuel consumption of the main engines was 0.395 pounds per brake horsepower hour and that of the auxiliary Diesel engines was 0.036 pounds, making a total of 0.431 for the whole installation. The performance of this ship will be followed with keen interest, since she represents a notable forward step in application of the Diesel engine to ship propulsion.

Stewart Bale, Liverpool

FIRST-CLASS LOUNGE, LOOKING FORWARD

*Compact machinery provides ample space for accommodations*



Stewart Bale, Liverpool

LOOKING ATHWARTSHIP IN ENGINE ROOM

*Top view of the four motors of 13,500 combined horsepower*

Mt. Wilson Observatory

WHAT STARS LOOK LIKE IN THE INTERFEROMETER

*Images made from laboratory sources of light which resemble exactly those shown by stars. The interference "fringes" disappear when the instrument is set for the star's diameter*

# The Star Called "Wonderful"

## Remarkable New Facts About the Star Whose Name Is Mira

*By Professor Henry Norris Russell, Ph.D.*

THOUGH the possibility of measuring a star's diameter is now a matter of common knowledge, the number which have actually been measured is still so small that each new observation deserves attention; and this is especially true when the star just measured proves to be larger (in apparent size, at least) than any which has previously been known.

We refer, of course, to the famous variable star Omicron Ceti, often known as Mira, the name given it by the discoverer of its variability more than three hundred years ago.

Very few stars have attracted more general interest than this, and with reason. To begin with, its variation is more conspicuous than that of any other periodic variable. At intervals of eleven months it rises to the fourth magnitude, or even to the third, and is easily seen by anyone. Halfway between these maxima, it is below the ninth magnitude and some two hundred times fainter. Although fairly regular, its variations do not repeat themselves exactly. For example, at one maximum, about twenty years ago, it was four or five times brighter than usual and of the second magnitude, so that for a few weeks it was the most conspicuous star in the large constellation in which it is situated.

### Glowing Hydrogen in the Star

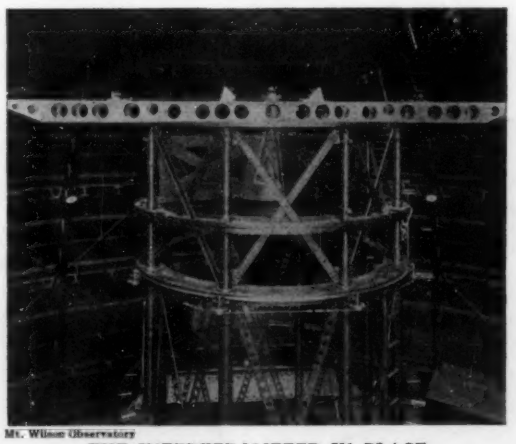
Spectroscopically it is also remarkable, showing, like hundreds of similar variables, a spectrum crossed by heavy bands due to the presence of the vapor of titanium oxide in its atmosphere, and usually containing bright lines.

Hydrogen shines very brightly near the maximum light, while at minimum many of the characteristic low-temperature lines of the metals are bright. As might be expected from its spectrum, the star is red, although not much redder than other stars, like Antares, which show the same bands in their spectrum but do not vary perceptibly in brightness.

The distance of Mira from the earth is too great to measure easily; but, applying the powerful methods based on proper motions to a considerable number of variable stars of similar type, it is found that on the average they are, when at maximum, about a hundred times brighter than the sun. If Mira is like the average (which is none too safe a guess), its distance from the earth must be about 150 light years, and its parallax about .02 second of arc. Although these values are decidedly uncertain, there is no doubt that Mira, like other long-period variables, resembles other non-variable red stars in brightness when it is at maximum. It is a giant star which periodically becomes faint, not a dwarf which sometimes grows bright.

A very striking confirmation of this conclusion is found in the work of Pettit and Nicholson, who have measured the heat which is received from this and several similar stars and find that, although the light may diminish a hundredfold at minimum, the heat falls off only to about one-third. The luminous efficiency, which means the ratio of visible light to total heat, is always low. Even at maximum, Mira gives but about one-tenth as much light in proportion to its heat as does a white star like Vega, while at minimum the ratio of light to heat may fall as low as one to five hundred.

This seems very remarkable but is easy enough to explain. It is a commonplace to every illuminating engineer that the luminous efficiency of an incandescent body is very small at low temperatures, but rises rapidly as the body grows hotter. This is why the tungsten lamp, the filament of which works at



Mt. Wilson Observatory

THE INTERFEROMETER IN PLACE

*This long arm on top of the telescope carries the movable mirrors which collect the light rays for the measurement of a star's diameter*

a higher temperature than the old carbon filaments, is so much more economical. Using the well-established relations between luminous efficiency and temperature, Pettit and Nicholson find that the surface of Mira, at minimum, comes out about 1,700 degrees, on the usual scale of "absolute temperatures," while at maximum it is several hundred degrees higher.

So low a temperature means a very small emission of light per square mile, and hence a very large diameter for a fairly bright star. Thus the long chain of reasoning leads to the anticipation of the results which have just been obtained.

Mr. Pease, working with the interferometer attached to the hundred-inch telescope at Mount Wilson, had long had Mira upon his observing list—influenced by just such considerations as have been set forth. The star proved, however, to be just too faint for observation with the original form of the instrument, in which four-inch mirrors were used to reflect the light. In 1924 larger mirrors were installed and the star, when at maximum, could be observed. No fringes at all could be seen until the mirrors were brought even closer together than was necessary in the case of Betelgeuse.

It may be remembered that these "fringes" (five parallel bright and dark bands), are produced by the interference of the light waves reflected from the two mirrors. The light from a luminous point should show these fringes, however far apart the mirrors may be set, but in the case of a disk of finite angular diameter the fringes weaken as the mirrors are separated and finally vanish, never again becoming strong enough to count for anything. The distance between the mirrors, at which distance the fringes disappear, is inversely proportional to the diameter of the star.

For Mira, even on the best nights, the fringes disappeared entirely with the mirrors ninety-eight inches apart—which corresponds to a diameter of .056 second of arc—thirty percent greater than the apparent size of Betelgeuse. With the parallax already estimated, this makes the true diameter of the star 260,000,000 miles—about the actual size of Betelgeuse and larger than any other known star except Antares.

### Mira Is Relatively Cool

Several interesting conclusions may be drawn from this result. In the first place, the surface brightness of the star, even at maximum, must be very low. A speck of the sun's surface shining through a hole of the same apparent diameter as the disk of Mira, would appear almost as bright as Venus or 1,600 times brighter than Mira actually does. A standard radiating surface, to appear as faint, would have to be at a temperature of only 2,200 degrees.

At minimum, when the surface brightness is only one hundredth of this value, the computed temperature is 1,600 degrees—hardly hot enough to melt steel. The good agreement of these temperatures with those calculated from the luminous efficiency inspires considerable confidence in the results. One puzzle, however, remains. A body as cool as this should be exceedingly red, much redder than any ordinary star. But comparison of measures made with the eye and on photographs shows that Mira, both when at maximum and at minimum, has about the color of an ordinary red star of surface temperature 3,000 degrees.

A plausible explanation is found in the existence of enormous bands in the green, yellow and red portions of the spectrum, which cut out a great deal of the light which affects the eye. The bands in the

blue and violet are much less prominent, so that the photographic observations are less influenced.

If the absorbing atmosphere which produces these bands could be removed Mira would look probably two or three times brighter to the eye, and would appear very much redder, as might be expected theoretically. Allowing for this, the surface temperature comes out perhaps 200 degrees higher.

Not only the temperature of Mira but its density, too, must be exceedingly low. Stars which give out the same amount of light, or, better, the same amount of heat, are usually of much the same mass. From the heat radiation of Mira, which is about 1,000 times that of the sun, its mass may be estimated as between five and ten times the sun's. Its bulk, calculated from the assigned diameter, is twenty-seven million times the sun's, so that its probable density is about one four-millionth part of the sun's density, or one four-thousandth that of ordinary air. This is the mean density. The outer portions of the star, from which comes the light which we see, must be far more rarified, probably with a density only a few millionths that of air.

### Star's Temperature Is Variable

Such a star would appear to be in an extremely early stage, one of the "youngest"—not in years but in its state of development—that we know of.

When we come to the more fundamental question of why these extraordinary changes should happen in the light of Mira, we can at least say something. It appears fairly clear that the immediate cause of the variation in brightness is a periodic change in the surface temperature of the star. This temperature change is in quite moderate amount, not more than twenty percent on either side of the mean. The enormous range of the variation in light arises mainly from the great decrease in the luminous efficiency as the star cools, aided probably by the additional atmospheric absorption produced by compounds which are formed in greater abundance in the star's atmosphere at the lower temperature. Could we see heat instead of light alone, Mira would look about as bright as Arcturus and would vary between its maximum and minimum by only a couple of magnitudes.

But why should such changes in temperature happen in the star? The best clue which we have is afforded by measures of the radial velocity. These show that Mira is approaching us when faintest and is receding when brightest, as if it were moving in an orbit. According to Joy's calculations this orbit would be 35,000,000 miles in diameter. This distance is so small in comparison with the size of the star itself that we may well have here another example of the "pulsations" which Eddington has used with so much skill to explain the variation of brightness of another class of stars—the so-called Cepheids.

These Cepheid stars vary in some respects like Mira. There is conclusive evidence that their surface temperature changes but their periods are much shorter and they vary through but a small range (of only a magnitude or so) and very much more regularly. Practically all of the many facts which are known about them may be explained on the assumption that they are alternately expanding and contracting, while remaining spherical.

Such a pulsation, if once it happened, would maintain itself automatically, like the oscillations of a pendulum. The inward motion of the contracting mass compresses it to a size smaller than normal and the rebound of the compressed gases expands the mass beyond the normal size, only to have it fall in and begin the cycle again. This motion of the surface alternately inward and outward is rapid enough to produce the observed shifts of the spectral lines. These shifts are not due to orbital motion at all, the diameter of the calculated "orbit" representing merely the change in the distance of the star's *surface* from us, while its center remains unmoved.

As the star contracts it grows hot at the core; as it expands it cools. If the changes in temperature at the center were immediately transferred to the surface the star would be hottest when it is smallest and coolest when it is biggest. But it takes time for the heat to work out from the center to the surface. Accordingly, the surface temperature lags behind and reaches its maximum when the star is expanding rapidly and its surface is approaching us. At this time the star is hottest, brightest and whitest. It is coolest, farthest and reddest while it is contracting.

On this basis Eddington has been able to calculate the diameters and masses of variable stars of the Cepheid type and to explain that remarkable relation between the periods of these stars and their brightness, which relation gives us our most powerful means of determining great astronomic distances.

When we pass to the long-period variables and especially to Mira, we find again that the observed radial motions can be interpreted as a change of the diameter, involving an actual motion of the star's surface toward, or away from, the center over a range of nearly forty million miles. This, however, would change the diameter by only fifteen percent on either side of its mean value. We have also a change in the surface temperature of about twenty percent on each side of the mean.

### Mysteries in Star's Pulsation

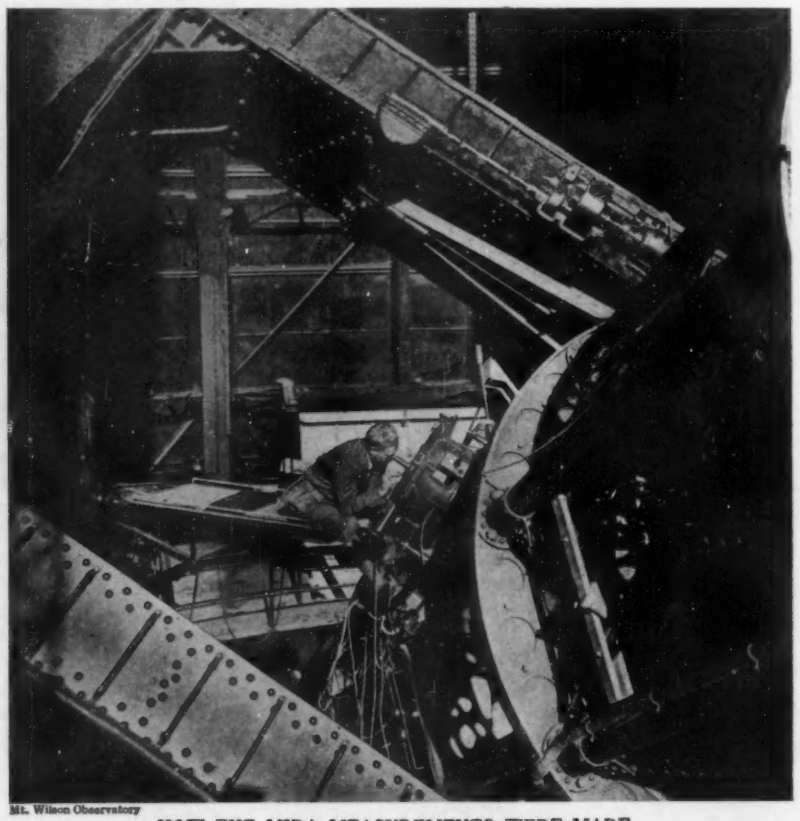
But very strangely this star Mira is hottest, not when it is expanding, but when it is contracting. What this means is not yet clear. The formation of chemical compounds in the star's outer layers as it expands doubtless tends to fill the spectrum with innumerable lines, and so to keep much of the light and some of the heat from getting out. But it is hard to see how this could delay the time when the surface gets hottest by the six months which intervene between the time of most rapid expansion and of swiftest contraction.

The numerous and remarkable peculiarities of Mira's spectrum also demand explanations which are not yet forthcoming. All in all, although we are beginning to have a fair notion that these long-period variables are huge giant stars of very low density and of the lowest known surface temperatures, we have little idea of how they work. But, with the present rapid progress of astrophysics, we may not have to wait many years for a solution.

Mt. Wilson Observatory

THE TELESCOPE WITH WHICH MIRA WAS MEASURED

*This great reflecting telescope, the largest in the world, carries at its lower end a mirror 100 inches in diameter. Note, at the left, the chair where the observer sits*

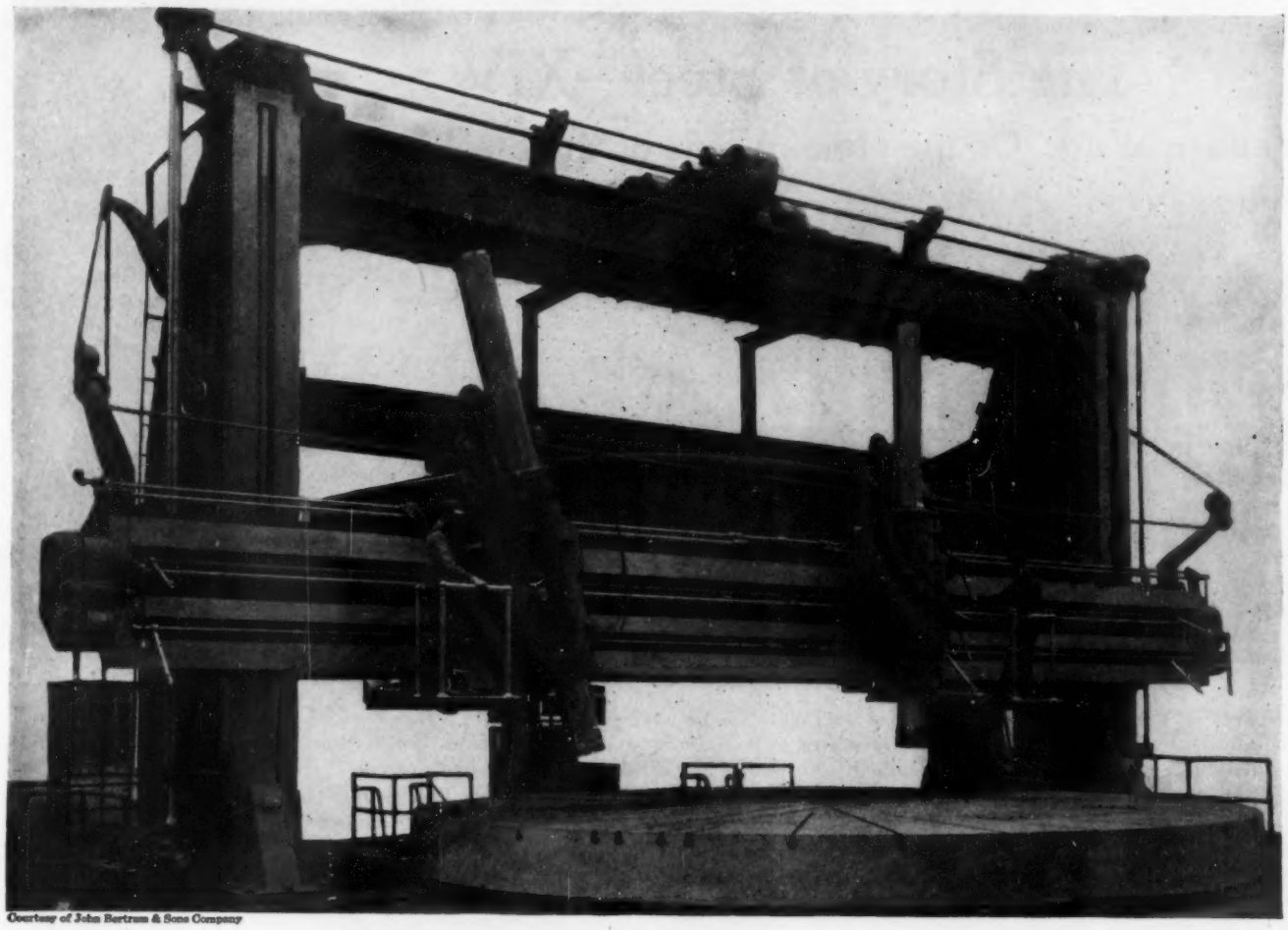


Mt. Wilson Observatory

HOW THE MIRA MEASUREMENTS WERE MADE

*Dr. Francis G. Pease is seated in the position occupied for the measurements of a star occupying Mira's place in the heavens. The mirror of the great telescope is below*

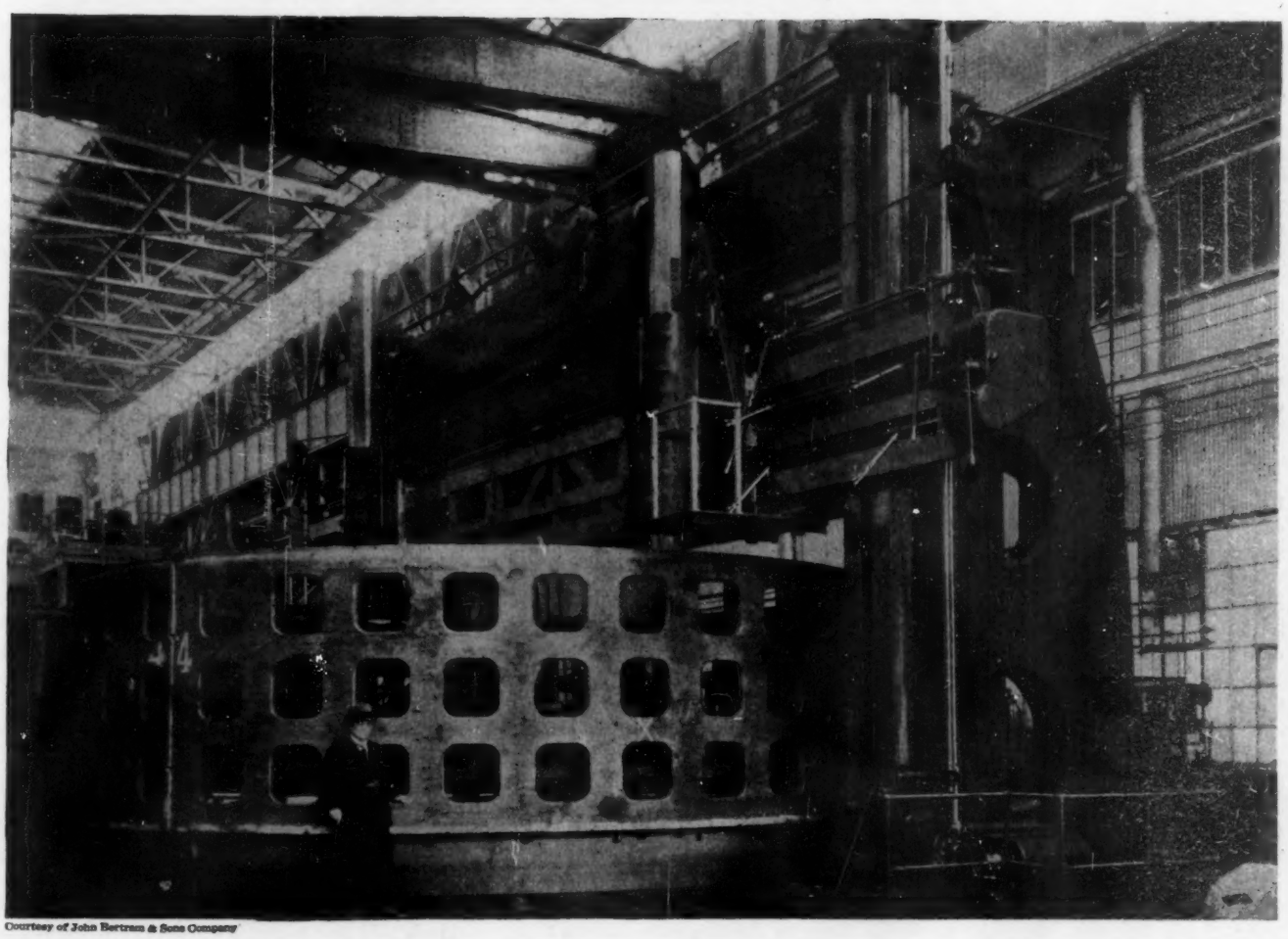
# A Three-hundred-ton Machine Tool



Courtesy of John Bertram & Sons Company

A LEVIATHAN AMONG TOOLS

*This 36-foot boring and turning mill was recently built for the Canadian Westinghouse Company at Hamilton, Ontario. In addition to being an extremely large machine it has some features of great interest to shop men. The dimensions are as follows: Actual swing of the machine 36 feet 2 inches; height under tools, 12 feet; vertical travel to boring bars, 8 feet; diameter of table, 28 feet; table designed to carry a weight of 125 tons. The table is rotated by means of a large spur gear. It rides on two annular tracks*



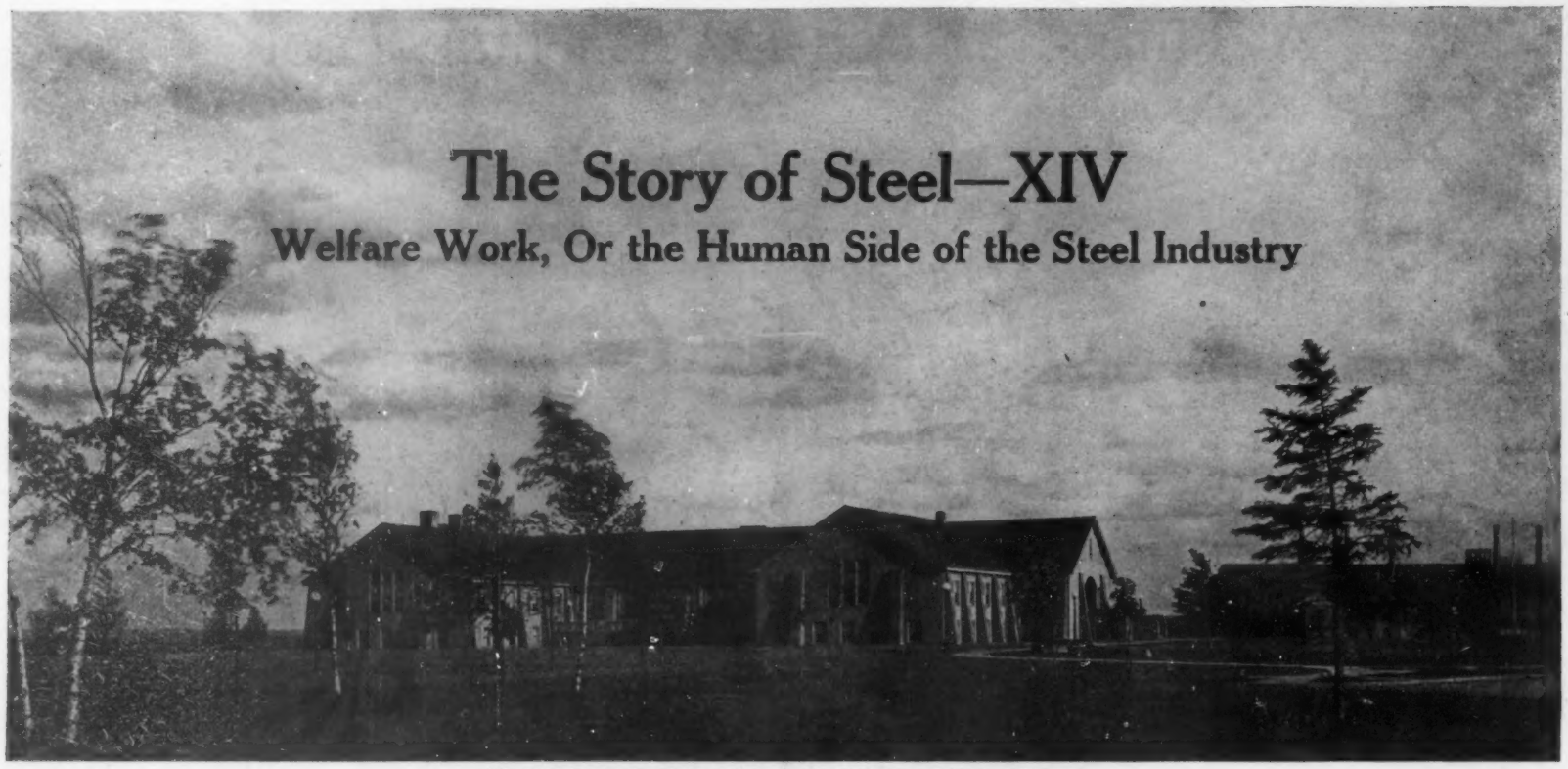
Courtesy of John Bertram & Sons Company

THE MASTODON AT WORK

*The crossrail is of the three-track type having narrow guides at the bottom. It is clamped to four slides on the housings, the clamps being operated by four motors, controlled by means of a push button. The boring bars are of octagonal shape, are 12 inches across the flats and about 15 feet long. Rapid traverse for the saddles and bars is provided for, and operated by a 10-horsepower motor and controlled from a push button station on the operator's platform. The control of feed and fast traverse is also centralized in operator's position on either side of the mill and also at each saddle. This mill is driven by a 60-horsepower, direct-current, variable-speed motor and, through two sets of back gears, gives 48 cutting speeds to the table*

# The Story of Steel—XIV

## Welfare Work, Or the Human Side of the Steel Industry



AN EMPLOYEES' CLUB HOUSE AT MORGAN PARK, DULUTH

IN THE preceding chapters of The Story of Steel, we have described the triumphs of applied science, invention and industrial organization, which have raised the steel industry of the United States to its present commanding position. The present chapter, which will be the last of the series, is devoted to a brief sketch of what in our opinion is the greatest triumph of all—namely, the bringing of capital and labor together in a bond of mutual human interest and understanding, without which the present prosperity of the industry would be impossible and its future would be sorely jeopardized.

The industrial pioneers of America were so occupied in the struggle to overcome obstacles and the development of processes, that they lost sight of, or could give only slight consideration to, the human side of steel making. They were men of courage who started the industry, and it took men of determination and perseverance to develop it to its present magnitude. In a period of about fifty years, thanks to their efforts, an industry has been built up which employs over 600,000 people and produces annually over $1,600,000,000 worth of a material which, as we have shown in earlier chapters, is absolutely essential to our modern civilization.

### Demand for Safety and Comfort

The aim of the various plant officials was directed to production almost exclusively, but times have changed and, although production is still the ruling factor, there has grown up a growing recognition of the claims of the working man, that his work shall be rendered safe and that his living conditions shall be improved to keep pace with the developments of our social life in housing, health and recreation.

"Today," says one of the leaders in this good work, "welfare work may be classified as one of the essential features in successful and efficient plant management." It will scarcely be disputed that in the work of bettering the conditions of labor in the steel industry, the leading spirit has been Judge Gary, the present venerable president of the United States Steel Corporation. It is significant that, during an interview before the writer undertook his lengthy trip through the steel industries, the whole hour of our talk was consumed by Judge Gary in outlining what had been done for the working man. Asked what he considered to be the most important requisite for a successful head of a steel plant, he replied, "I would place first a thorough knowledge of human nature, as exemplified in the American working man, and an understanding sympathy with his point of view."

### A Great Welfare Organization

Our last chapter was devoted to safety work, and in the present chapter we shall deal, only too briefly, with what has been done in the way of general welfare work. It was shortly after 1906 that the steel corporation appointed a safety committee comprising officials of the corporation and representatives of the larger subsidiary companies. The work grew to such an extent that there was organized, in March, 1911, a central station which was known as "The Bureau of Safety, Sanitation and Welfare," which was placed under the management of Mr. Charles L. Close.

In addition to the work of accident prevention already dealt with, the work of this bureau is grouped under some score of welfare activities. Obviously, we can touch only lightly upon a few of these institutions, and we must leave the telling of the story to the accompanying photographs.

First aid and rescue crews have been formed, whose object is to have especially trained men to take immediate charge where a life is imperiled. After first aid the victim is carried at once to a completely equipped emergency hospital, and we show one of these recently built at Fairfield, Alabama, by the Tennessee Coal, Iron and Railroad Company, at a cost of over one million dollars. The corporation early realized that the burden of caring for the injured should be borne by the industry, and they established a voluntary accident relief plan, thereby anticipating the workman's compensation law which was subsequently enacted by the various states.

The Committee on Sanitation has prepared specifications which include regulations for toilets, wash and locker rooms and drinking water. To avoid infection no wash basins are installed—the men wash in the flowing stream. Sanitary fountains are used exclusively and sources of drinking water are periodically inspected and the water analyzed. The drainage of marshes and lowlands and the use of crude petroleum have reduced the cases of malaria fever in certain districts from six thousand to two hundred annually.

The provision of plant restaurants eases the home burden of the housewife by relieving her of the daily preparation of the dinner bucket, and a half an hour earlier to the mill enables the employee to take his breakfast at the restaurant rather than at home, if he so wishes.

A notable work is the institution of clubs and some extremely fine buildings have been erected in this connection. The Good-Fellowship Club was organized for the mutual help of all of its members. It assists in the payment of insurance policies, and the visiting nurse on relief work gives assistance and instruction for the comfort and welfare of the families of the members. The visiting nurses, whose services are offered free by the company, visit the homes of the employees on request. They attend the sick, give instruction in domestic hygiene, advise the families in their various troubles and conduct day nurseries for the children.

The practical housekeeping centers teach the preparation and cooking of food, the care and feeding of babies, dressmaking and domestic science.

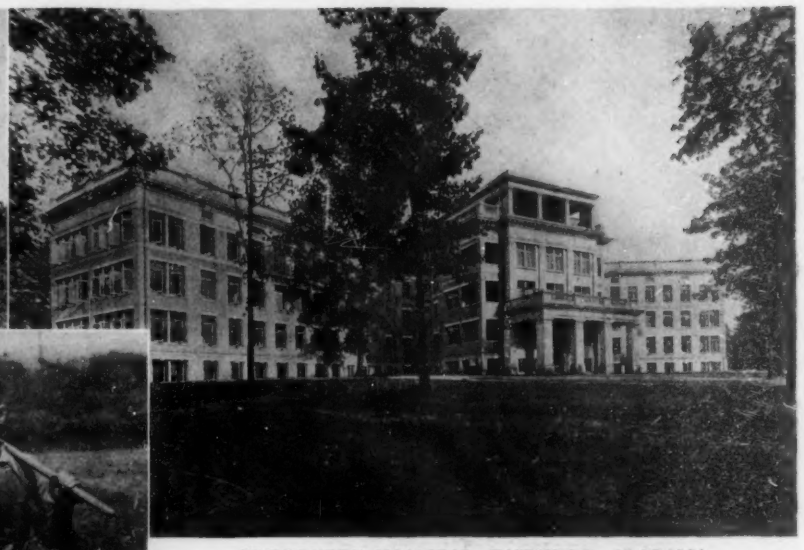
### Housing and Model Villages

In connection with some of the steel works, whole villages have been built from the ground up, where homes fitted with all the modern conveniences are provided at moderate rentals. Gardening is encouraged by the offering of prizes for the best gardens, and the company usually plows the community gardens at its own expense, plots it out and directs the workmen in their gardening activities. Flower gardening at the works is encouraged and is done mainly by the employees. Limitation of space prevents any detailed notice of the various picnics at which the musical bands of the workmen play, or of the large extent to which athletics are encouraged.

We cannot close without mention of the educational work carried on and of the endeavor to thoroughly Americanize the newcomers from Europe, and also the stock subscription plan which has been so successful that by April 20, 1920, over forty thousand employees were stockholders, and their holdings represented a total of $18,600,000.

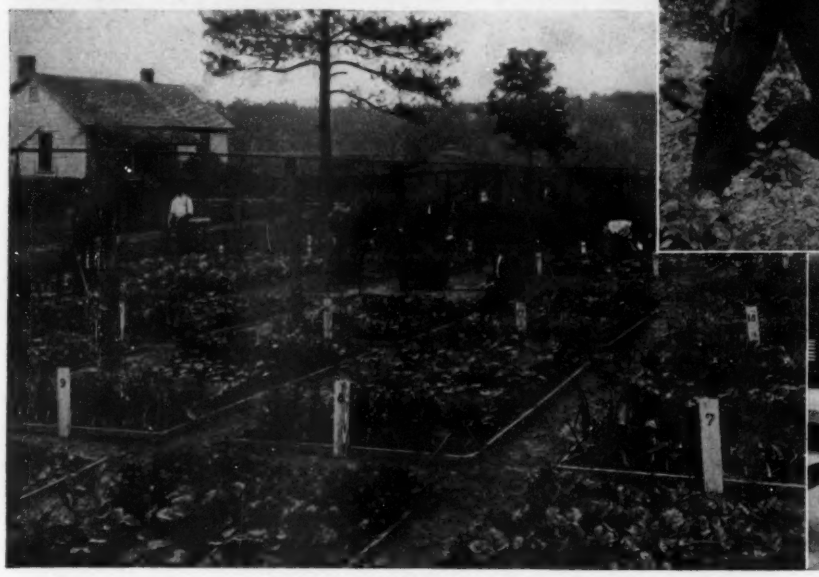
AN EMPLOYEE'S COTTAGE

*This charming, six-room bungalow is situated in a suburb built for employees of the Minnesota Steel Company near Duluth, Minnesota*



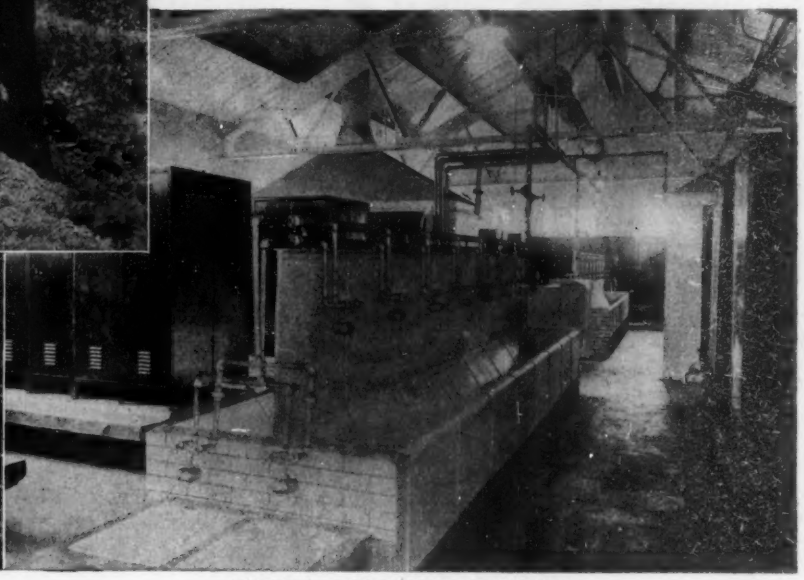
EMPLOYEES' HOSPITAL, FAIRFIELD, ALABAMA

*This fine three-story and basement building, accommodating 348 patients, is equipped throughout with the most modern facilities*



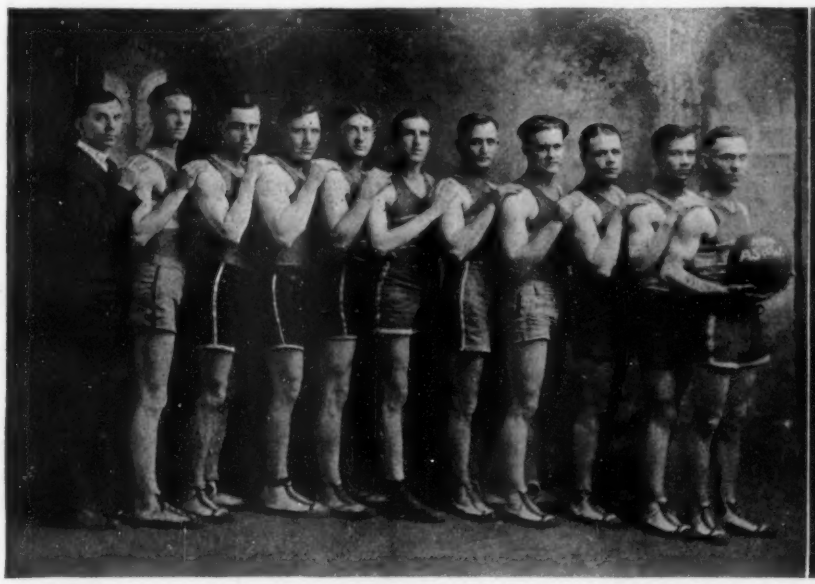
TYPICAL SCHOOL GARDEN

*The Corporation encourages and teaches garden cultivation. Here is a school garden for children. "Dad" (see insert) has come straight from the mine to his garden patch. Many of these gardens are on unoccupied land of the Corporation, which the Company ploughs up ready for the making of gardens*



TYPICAL SANITARY WASH-HOUSE

*Here we see a typical, wash, shower, and locker room. Note absence of basins. Men wash in running streams of water, to avoid infection. All is kept spotlessly clean. Shower baths are provided and the men can clean up and change to street clothes before leaving the works*



MILL HANDS AT PLAY

*This fine group of athletes is made up of mill hands employed by the American Steel and Wire Company. They are known as The Anderson Works Basketball Team, and were the winners of the greatly coveted City Industrial League Championship in the 1923-1924 Series*

AMATEUR THEATRICALS BY THE OFFICE FORCE

*An important part of the work of the Welfare Bureau is the promotion and oversight of indoor recreation, of which amateur performances by employees form an important feature. The "cast" shown above was made up from the staff of the Carnegie Steel Company, Pittsburgh, Pennsylvania*

# What Are the Sounds that Insects Hear?

*By S. F. Aaro*

There

CAN insects hear? Some of the insects that have a very definite purpose for detecting sound connected with their love affairs, are endowed with auditory powers, but this special provision does not apply to most species.

Very little seems to have been discovered concerning the detection of sounds by the invertebrates; anatomically we only know that they have no auditory apparatus like those developed by the vertebrates. Anything in the nature of a tympanum, a sense-attached disk or drum for the reception of waves of sound seems to be peculiar to the creatures with backbones.

### Few Insects Can Hear

Being comparatively diminutive and having a nervous construction susceptible to touch, sight, taste and, most delicately, to smell it would appear natural that a disturbance of the atmosphere resulting from any kind or degree of noise must be readily detected, especially through such sensitively attached organs as the antennæ, the palpi, the wings and even the legs. But with the exception of the very evident hearing of certain families of grasshoppers, crickets and beetles, the males of which call the females by stridulating, there seems to be no evidence, after careful observation, that the majority of invertebrates have any sense of sound as conveyed by the atmosphere.

The antennæ would seem to be the most likely organs of hearing. The females of katydids, true and false, of the crickets, those of the death-watch and certain longicorn beetles very observedly use their long and slender antennæ in locating the call notes of the other sex. These flexible, so-called feelers are constantly moving so as to locate the sound and they no doubt guide these insects in their response to a musical or noisy serenade. This fact might also lead to the conclusion that other insects with similar antennal development should be able to detect sound, but where there are no special reasons for hearing in addition to the ever present one of detecting the nearness of an enemy there seems to be no auditory development of any sort.

It is difficult to locate the organs of sense in insects, other than sight and this is complicated because of the single ocelli and the multiplications of the disks. It is also hard to determine the extent of these senses by observation of the sense-registering organs. Arthropods breathe through their trachæ; it would seem that they should receive odors in the same manner as do the vertebrates, but instead they have special organs of smell. It is possible that these highly sensitive head attachments merely come into play to aid, through determining odors, the far less sensitive hearing or meager susceptibility to sound.

### Susceptible to Vibrations

Experiment does more than all else to determine the factors of sense, sometimes very completely upsetting theories. There seems to be no evidence that the delicate antennæ of most insects are susceptible to sounds of any kind because some species are. Has nature merely made these organs in the stridulating species susceptible to sounds and developed a minor discrimination therewith, or perhaps made them susceptible only to certain vibrations? A female cricket will pay no attention to the stridulation of a male of any allied species, nor will she give the slightest heed to the scrapings of a violin, except when they are a close imitation of those made by her own species. This is the case also with the true katydid and the larger false katydid, the males of the latter making a clicking sound like the striking together of small pebbles, but this sound may be closely imitated without the discriminative katydids giving the least indication that any sound is apparent to them.

### Shed Legs with Equanimity

It has been claimed that the organs of hearing of the katydids and crickets are to be found in the front legs. There is a widening of the tibia that permits of a broadened cleft within which is a sort of disk not unlike the inner ear drum or the tympanum of a fish. But it may be proved that these organs have little or nothing to do with receiving sound. Grasshoppers and crickets as a means of escape readily cast off a leg when that member is seized by an enemy and this evidently causes no particular discomfort judging by the subsequent actions of the insect. When the two forelegs of a caged female of the large false katydid were separated from her she very soon resumed the quest for the stridulating male hidden among a tangle of twigs and leaves in the same cage, the antennæ un-

doubtedly directing the search. Moreover, the males of certain crickets do not possess these supposed auditory appendages in the legs. But these crickets are nevertheless susceptible to the stridulations of other members of their own sex and species, as may be shown by their striking up in animated rivalry.

It seems strange that the sensitive antennæ of butterflies and those of certain moths that possess many branched, feather-like or hair-like feelers would not be sensitive to the most delicate disturbances of the atmosphere and attuned to certain sounds in order, at least, to warn them of approaching danger. But after long, frequent and varied experiment it has not come within the power of the writer to discover any sound-making scheme or instrument to which these or most other insects will respond.

### Sounds Not in Ken of Butterfly

I have experimented most in this respect with certain butterflies, larger Geometrid and Noctuid moths, with bees, wasps and blue-bottle flies in each case choosing an example that was alert and engaged in nothing for the moment apt to compel its attention.

Finding in the woods near my home a blue Basilarchia sporting in a certain restricted spot, as is its habit, I resorted thither with several kinds of sound-producing objects: a penny tin horn, a tin pan on which to beat and scrape and my own whistle

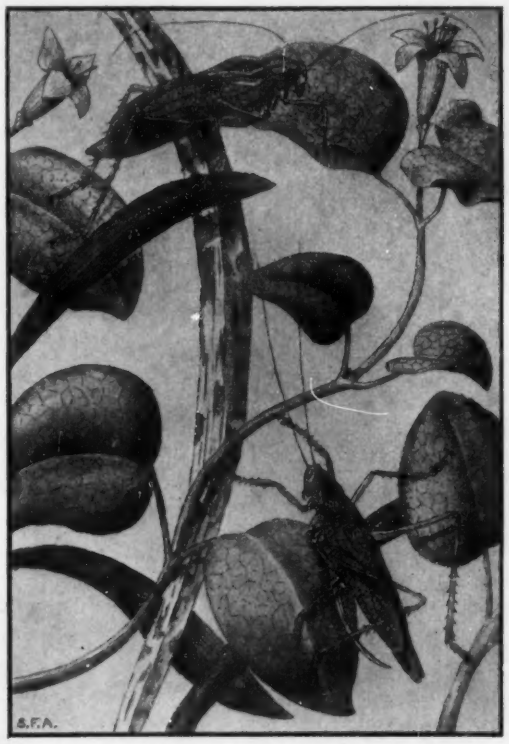
HE IS AWARE OF SOUNDS

*An adult beetle of the round-headed apple tree borer, showing that he is not displeased by the scrapings of a violin bow*

and voice. I approached most stealthily from down wind and stood within a few feet of the insect during a prolonged display of nearly every shrill, harsh, grating, rasping, and jarring noise within the entire gamut.

But there was not the slightest indication that sound was a condition in the ken of this alert butterfly; that there was such a thing as the vibratory waves of air. The little creature, ready to take wing upon the slightest alarm coming through deterrent odors, or the merest motion, did not once turn in the direction of the sounds, nor even slant its antennæ toward it. It did not show the least nervousness until after I had returned to the house for a shot-gun and then, within a yard of the insect again, fired the weapon over my shoulder so that the flash and the disturbed foliage would not be seen. The effect was merely a flit of the wings probably in response to the concussion.

Similar if somewhat less extensive noise-making trials with those other insects and with certain



AN INSECT SERENADE

*A pair of long-horned grasshoppers staging a prolonged courtship; the male (above) stridulating by scraping the cross veins at the bases of the fore wings in fiddle fashion thus attracting the female, who seems to locate the sound by means of her antennae*

spiders have given like results. Dulcet tones in varied keys—rasping, whirring, bubbling, screeching, whistling, shouting sounds and detonating noises—are either regarded as of no importance by these creatures, or else were not apparent to them. And if they could hear would they not, as with their eyes, have come to discern sounds that might indicate the approach of danger, or even those sounds that might allure?

### Further Experiments Planned

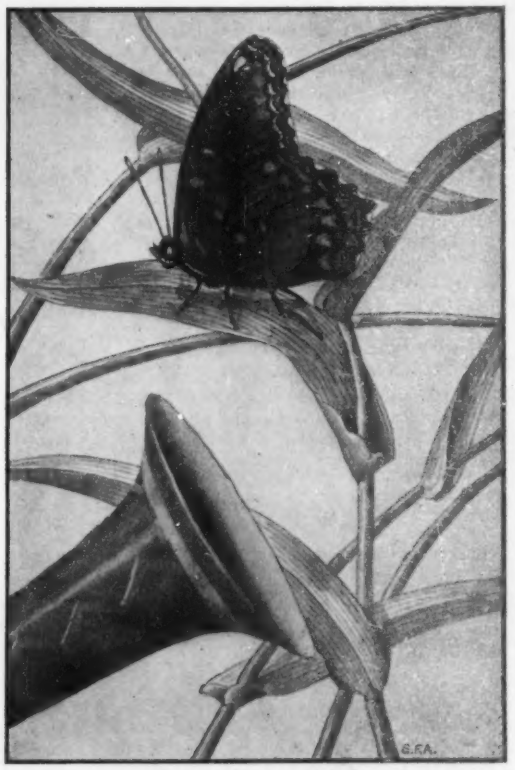
I regret that similar experiments have not been tried upon the long-horned grasshoppers; I only know that firing a gun in the woods near nightfall in late summer and when the broad, concave-winged locusts have begun katydiding with all their energy will serve to check some of them for a moment; at least those that are nearest. I know also from observation that a Cerambycid beetle, the two-striped adult of the round-headed apple borer, will show very decided evidences of hearing certain noises made near by and these quite unlike the ticking call note of the males. Whistling loudly made it turn toward the sound and elevate its long antennæ and a clapping of the hands so as to produce a hollow reverberation caused it to turn and crawl away. The long single scrape of a violin bow across the strings seemed to be an attraction.

Ants also are an exception to the majority of insects with regard to detecting sounds, though no more so than to be peculiarly susceptible to jar, not only of the ground, which would be most natural as indicating the approach of an enemy and is no doubt transmitted through the six slender legs, but also to a loud sound above them, as the clapping of hands, or the striking of two stones together. Other sounds not the least like anything that they could consider alarming, as, for example, whistling, shouting or the loud playing of a mouth organ, make no visible impression upon them as far as one can see.

Further experiments should be made (and they will be made), concerning not only the hearing of arthropods, but with regard to their other senses and the powers of discrimination. The invertebrates generally, however highly specialized some of them have become, as the ants, wasps, bees and termites, have not developed discrimination to the same extent as many vertebrates. Very often by sight, smell or hearing they do not recognize their foes. Casual circumstances disturb them, as the falling of a leaf, a changing shaft of light, many things that can mean no danger, but mammals, birds, reptiles, batrachians and even fish commonly recognize only harmful occurrences and actual dangers.

### Discrimination Parallel with Senses

And here we may be allowed to draw some conclusions. Discrimination to some extent has governed the development of the senses and is commonly parallel therewith; it plays an easy part with smell in merely detecting a strongly deterrent or injurious odor, or an attractive one suggesting food. With sight such as insects possess there must be some identification of form in motion, but this is exceedingly limited. Sound, being far less variable



CAN A BUTTERFLY HEAR?

*A blue Basilarchia apparently totally unaware of the loud trumpetings of a tin horn which is blown but a few inches away from it*

than either sight or smell, requires a more highly developed discrimination in the process of connecting it with the proximity of an enemy; there must be more than the identification of the mere jar of a big noise. There is the rush of unseen feet or wings, the fall of a dead tree limb at a distance. A jar may be received without the development of special auditory apparatus, as is the case of boring beetle larvæ.

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THE WONDERFUL WEAVER OF WEBS *an interesting article about spiders and their habits. By Ewald Schild of Vienna University. In our July issue, out June 20th.*

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Various Arts and to Patent News*

Conducted by Albert A. Hopkins

This can opener leaves a smooth edge which eliminates any danger of injuring the hands

## A Can Opener for the Kitchen

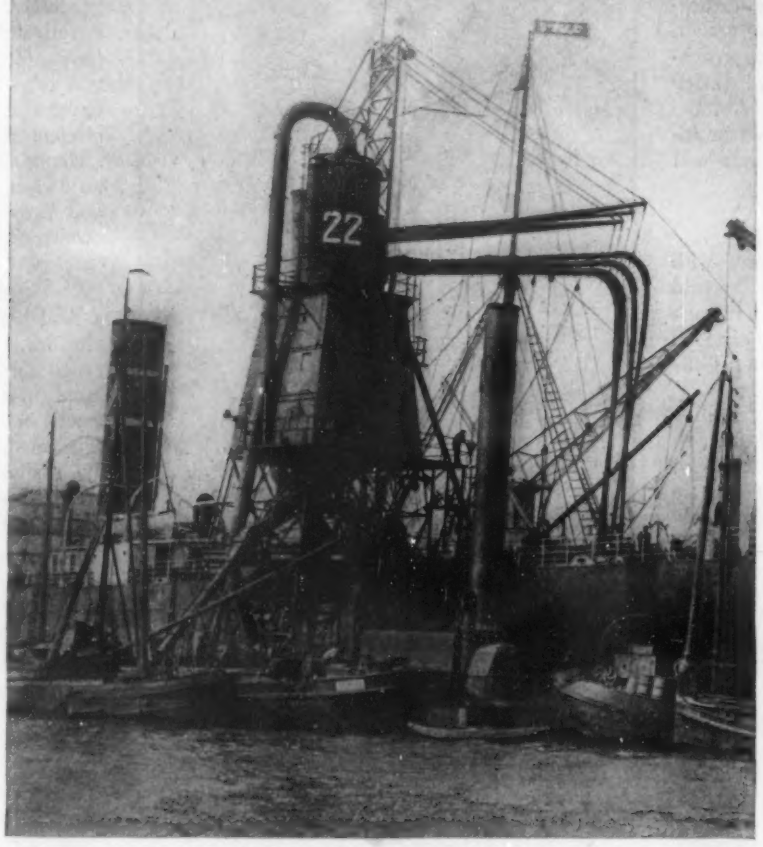
THE can opener illustrated supplies the missing link in the well equipped kitchen. Opens any can, oval, square or round—large or small, with equal ease. It leaves a perfectly smooth, round edge which absolutely eliminates all danger of injuries or cuts to fingers while can is being opened.

As there is no projecting, ragged edge to the opened can, the contents may be emptied whole. The can need not be held while being opened. Any can is opened much more quickly and easily than by old-fashioned methods.

To open a can it is only necessary to put handle in upright position, place can beneath knife, press down handle and turn same. It insures a definite place for opening cans, and eliminates all delay in looking around for an old style can opener.

## Bores Eight Feet Deep in One Minute

THE telephone pole hole digger illustrated here works like an auger bit, boring a hole two feet in diameter and eight feet deep in one minute.




Oil storage tanks in the harbor of Rotterdam, Holland. For the quick fueling of oil-burning steamers

The digger is mounted on a 10-20 horsepower kerosene tractor and power to operate the auger is taken from a shaft running out of the transmission. Power is also supplied to operate a winch and derrick with which the poles are lifted from the ground.

The tractor can be moved from the location of one hole to the next at the rate of four miles an hour. It is equipped with rubber tires, instead of lugs so that it can run on city pavements without injury to them.

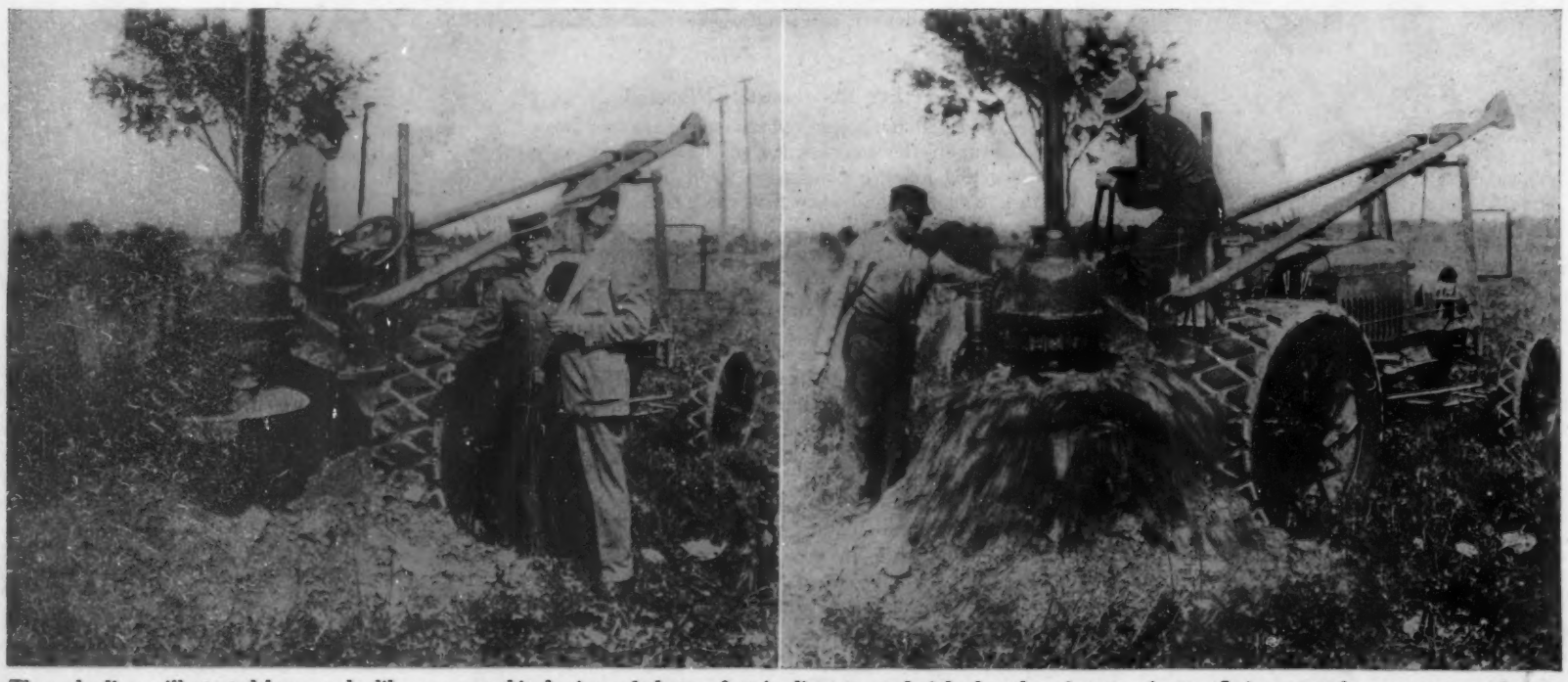
An electric collar press which eliminates creases in the surface of the collar

## An Electric Collar Press

WHAT will undoubtedly prove a boon to bachelors and other unfortunates, who have no wives to check up their laundry and see that there is a clean collar in the bureau, or who must iron their own collars, has made its appearance.

It is nothing less than an electric press for collars. No longer is it necessary to fume and fret because the only supposedly clean collar has vanished. All that is required is to wash out the desired collar; and then after starching, by simply placing it over the lower portion of the press, and slipping the top portion over it and turning on the current, a laundered collar is obtained.

It is apparent that much unnecessary work in ironing collars at home can be eliminated by the use of this useful and ingenious invention, and the results will, in the majority of cases, be much better than by the old method which sometimes left creases in the surface of the collars.



The pole digger illustrated here works like an auger bit, boring a hole two feet in diameter and eight feet deep in one minute. It is mounted on a tractor and may be readily moved from the location of one hole to that of the next

Gaging the slice

### Even Slicing of Bread

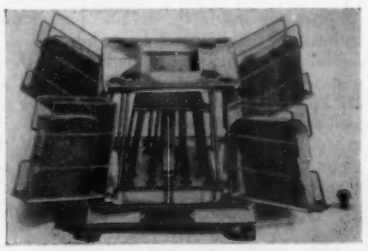
IN the implement illustrated here the slices of bread are cut evenly by reason of the guide which stops the onward progress of the loaf until the uniform slice is cut. Where sandwiches are to be made it is very essential to have slices of uniform thickness. The construction is obvious.

### Tuckaway Folding Ladder

A DEPENDABLE ladder is a necessity in every household, and one that can be thrust away is an added convenience. The construction is shown by the picture which shows the ladder ready for use and how it folds up. It weighs fifteen pounds and could support a 500-pound man, if necessary. There is no danger of the ladder folding up as is the case with many devices of this kind. The method of operation is clearly shown by the pictures.

### A Fish Broiler Is No Luxury

RECENTLY the editor of this department was passing through a large dry-goods store and his attention was struck by what appeared to be a long toaster which would accommodate a half dozen slices of bread. This was found to be a fish broiler. While this is not new, it is perhaps worth showing for the benefit of our women readers who would like to know of some kitchen utensil for use for fish alone.



A novel mutiple, electric toaster

### Better Pan Scraper

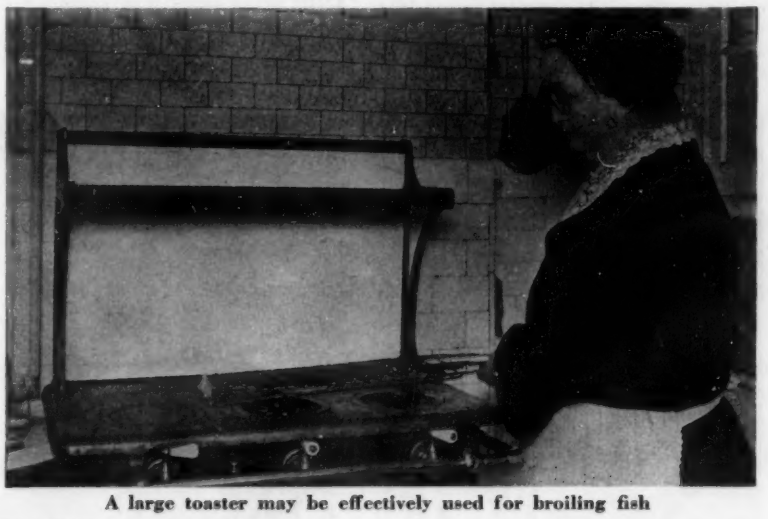
AN ordinary dish-cloth does not answer the purpose when burned food is to be removed from a pan. The scraper illustrated is a wooden handle to which is securely fastened a circular portion of a metal fabric cleaning material. This device is especially good in cleaning glass baking ware.

A handy pan scraper

An ingenious folding ladder

### Defying the California Borer

BRASS and copper were the only metals not penetrated by the California lead-cable borer in tests conducted by the Bureau of Entomology.



A large toaster may be effectively used for broiling fish

### 12,228 Electric Signs in New York City

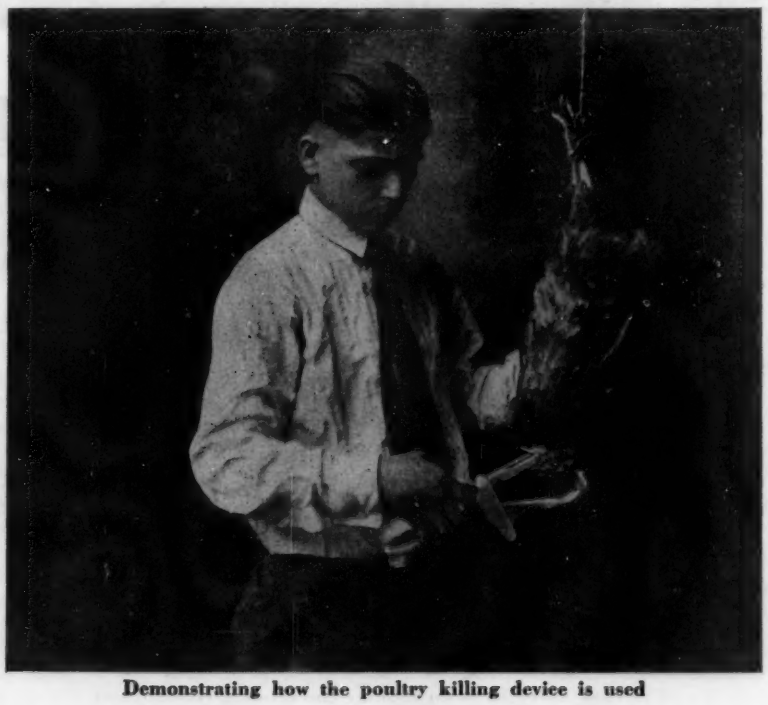
A CENSUS made public recently at the Electric Sign Exhibit of the New York Edison Company disclosed that there are 12,228 electric signs in Manhattan below 135th street. These utilize 1,121,223 lamps. Restaurants are in the lead with 2,381 signs and barber shops come second with 904. Theaters, with 522 signs, are seventh on the list.

### Steel Balls that are Circus Performers

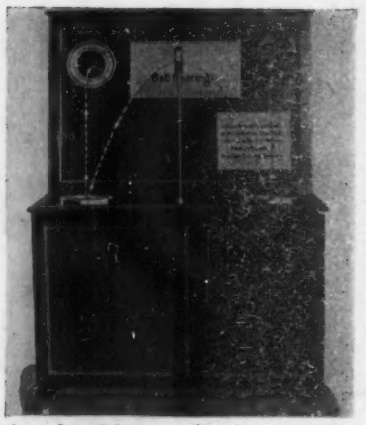
HERE is a test that proves whether steel balls for use in ball bearings are of uniform elasticity, sphericity, diameter and hardness. A manufacturer of steel balls has placed on exhibition an apparatus through which the balls are run, and which automatically throws out the few balls that do not come up to standard.

One by one, at intervals of a second, the balls issue from a spout within the circle in the upper right corner of our illustration. Falling to a hardened steel plate they bound upwards and to the left. If they are perfect they pass through the ring whose edge shows in the center, and landing on another steel plate they bound into the hole at the left.

So perfect is the adjustment of the controlling plates that these balls run through this remarkable performance with great precision.



Demonstrating how the poultry killing device is used



An advertising novelty that sorts the steel balls that are used in ball bearings

### Automatic Poultry Killing Device

A NEW device, properly gaged to cut and bleed the smallest broiler as well as the largest turkey, is illustrated on this page. This device works so quickly and smoothly that within a few seconds the killing of a fowl is completed. The fowl suffers in no way and poultry killing is made easy, quick and humane. This automatic poultry killing device is so arranged that when not in use it locks, so that the owner can carry it in his pocket. A pressing of the handle will unlock the device. It has a recommendation from the United States Department of Agriculture.

The most important thing in poultry killing is a generous draining of the fowl's blood, and, according to the United States Department of Agriculture, at least thirty percent of all the poultry coming into New York markets is incompletely bled. This is said to result in a loss of from two cents to five cents per pound.

An automatic poultry killing device

### Corn Cutter for Home Canners

THE cutter shown can be used in the home or by small canners. Six knives are attached to the cutter head and arranged so as to operate irrespective of the size of the cob. The push bar actuated by the crank feeds the cob.

A useful cutter for corn

Combination lock and deadlock

## The Fool-and-Burglar Proof Lock

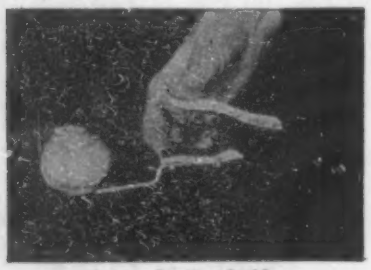
WHY not combine the doorknobs and the shank that connects them with the lock and nightlatch of the door? This is just what a San Francisco manufacturer has done. The knobs of the door fixture illustrated on this page, work just as any doorknobs work. In addition to this, however, there is a keyhole in the center of the outside knob as well as a large metal button in the center of the inside knob. When you insert the key from the outside and turn it, you also turn the latch with it, and the door opens.

When you wish to latch the door from the inside, without in any way precluding the use of the key from the outside, you simply press with your thumb against the center button of the inside knob. In addition to this feature, when you want to open the door from the inside after it has been latched, all you have to do is turn the knob just as if it had never been latched at all. This automatically permits the center button to snap out. But the sneak thief cannot possibly do this from the outside.

Rubber facing instead of rubber heels

## Eliminating the Washroom Hog

ONE of the annoyances of Pullman sleeping car travel is what people call the washroom hog—the individual who, after having made his toilet in the morning, proceeds to turn the room into a smoking room, thus occupying space needed by later risers for their hand baggage, clothing and toilet accessories. The Pullman Company have solved this problem.



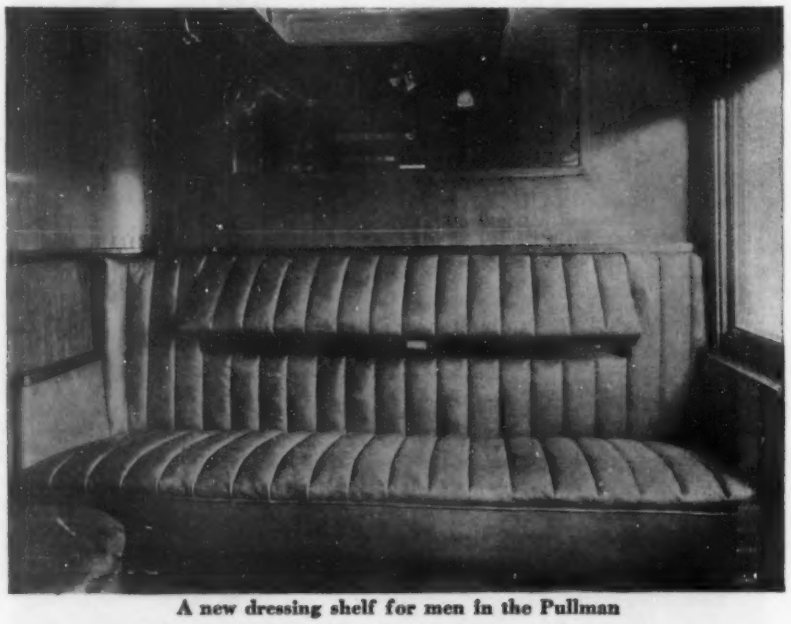
A novel yarn holder

A toast warmer that comes from England

Back of the seat ordinarily given over to the smoker is a shelf which can be pulled out by the porter. This gives the men what the ladies have long had—a dressing shelf—and practically doubles the old-time seat space for suitcases and toilet articles.

## No More Cold Toast

THIS device comes from England and is a silver toast rack which rests on a heated silver plate. An alcohol lamp under the plate keeps the toast hot.



A new dressing shelf for men in the Pullman

The shelf above let down showing the dressing conveniences

No more broken bulbs

## Safeguarding Your Bulbs

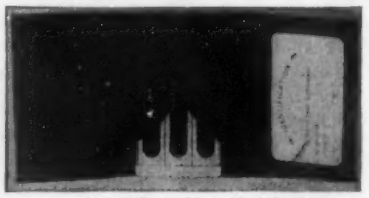
AN arrangement for carrying extra bulbs used about an automobile. The heart-shaped carrier is swung back of the instrument board when not in use. It is out of the way and in a location where nothing can come in contact with it to break the bulbs.

## Substitute for Rubber Heels

THIN, light-weight rubber facings, which can be easily applied in a few minutes to any leather soled shoes by means of special cement, will provide the velvety feel of live rubber when walking.

## Holding the Yarn

A RECENTLY invented convenience for the knitter and sewer is this thread or yarn holder. It clamps anywhere and prevents loss of the ball.



A pocket dime bank

## Promoting Thrift

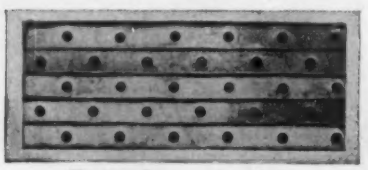
TO help in promoting saving, a dime bank that fits inside the middle pocket of a wallet has been invented recently.

The device is made of aluminum and brass and weighs only one ounce. Six locks are all opened simultaneously by a handy device kept by the bank as a rule. The coins are passed through slots in the top of the metal container and cannot be taken out without the use of the unlocking device.

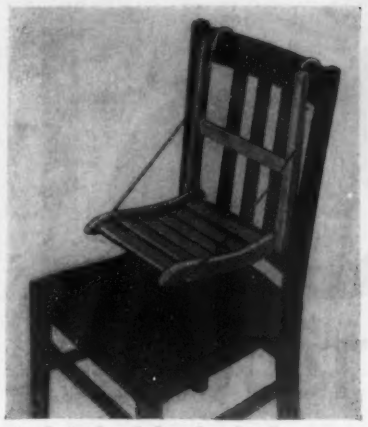
## A New Suction Belt

"TENTACULAR" consists of an oak-tanned leather backing, to the under surface of which are attached narrow longitudinal strips of a special kind of chrome leather treated with tallow. These strips are held in position by means of hollow brass rivets.

The depressions surrounding the rivet ends, combined with the blind holes in the rivets act as suckers during use and still increase the very high adhesion of the strips. Furthermore, air pockets between belt and pulley, which is a very common cause of slippage, are quickly squeezed out into the spaces between the strips.



Tentacular suction belt



A chair for baby that hitches on a grown-up's chair

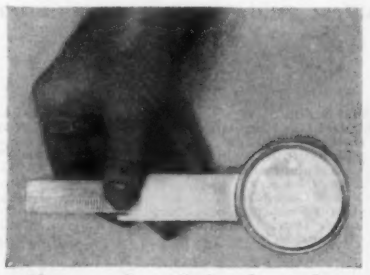
### Eliminating the High Chair

THE device shown is so obvious that a description is almost unnecessary. Simply hang the smaller chair on the larger chair and you have a practical baby's chair.

### Combination Mirror and Comb

A COMBINATION mirror and comb for the vest pocket, lady's bag and so on, is shown here.

Its design makes it so that it is not easily pulled from a vest pocket and yet it is instantly available.



Mirror and comb for the pocket

### It Cuts as It Rolls

THE rotary biscuit-dough cutter illustrated costs only a trifle and is very efficient. It can be used to cut biscuits, cakes, cookies, and so on. Its operation is clearly shown in the illustration.

### Doing Away with the Menace of Anthrax

TO promote health and cleanliness by elimination of the use of one shaving brush for many persons in a barber shop, a sanitary shaving soaper that makes lather and sprays it for use on the face, has been invented by, and is being manufactured by a New York concern. It is now being widely adopted in barber shops.

A sprayer which eliminates the shaving brush

### Making Acid Trays for Battery Jars

AN excellent tray for battery jars or any similar purpose is made by impregnating a heavy cardboard box with a mixture of pitch and gutta percha. The cardboard box must be warm before coating with the composition. Gutta percha must be melted over a water bath and not over the open fire. Take a pan of water; heat, add salt and float a tin pan on top in which the gutta percha is slowly melted then add an equal quantity of pitch (measured by weight). When the mixture is complete pour into box and remove the excess after all the surface is covered. The result should be acid proof.

A rotary biscuit-dough cutter

### An Electric Lamp that Shows the Time

CLOCKS and lamps have been combined before but have rarely been so well interlocked as in the instance illustrated. One has only to turn on the lamp and the time is visible on the clock set into the lamp standard.

### Shaving Cream in Handle of Brush

WHEN the shaving brush illustrated is wet it is ready to produce a good lather for shaving. The soap is in the handle, and a valve opens when the bottom is pressed and permits sufficient cream to flow to permit a good lather. The handle holds a supply sufficient for two months' work.

A lamp that also tells the time

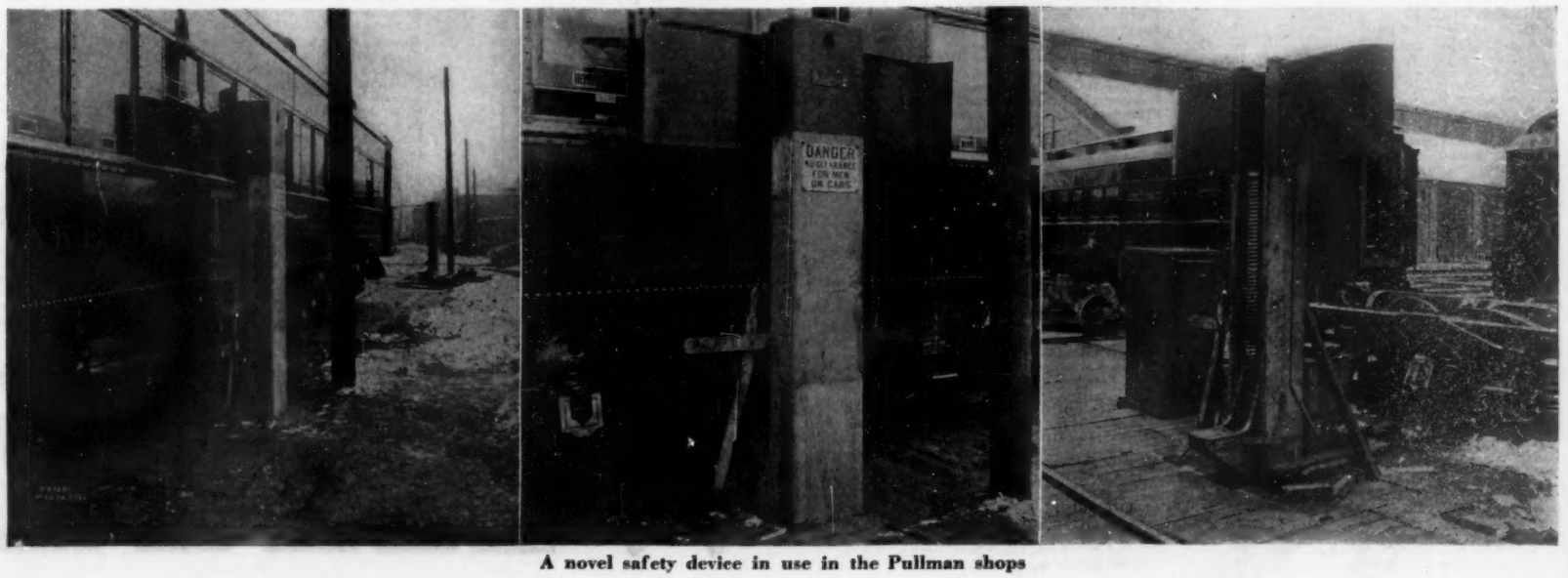
### Guarding the Car-lifting Operation

A CLEVERLY designed safety device to prevent cracked heads in the shops of the Pullman Company has been installed in connection with the lifting jack which raises a car from its trucks so work may be done underneath the car.

The jack screws are enclosed in four posts. A car is switched on or off a track, or table, between these posts by the transfer table that has moved the car from shop or yard track. It can readily be seen then that when a car is being hauled to the lifting table, anyone whose head happens to be out of a window is facing the danger of getting it cracked or even of being decapitated.

The middle picture shows the "tell-tales" and why they will prevent injury. The right-hand picture is a view of the "tell-tale" from the rear, while a car is on the jacks. The left-hand picture demonstrates how the device acts as a sudden warning and insures against injury.

Shaving cream is contained in the handle of this brush




A novel safety device in use in the Pullman shops

# ANNUAL Roll C

# WHITE TRUCK FLEE C

**Again this year we publish a bigger, greater White Roll Call. It is the most convincing performance document in the field of motor transportation. It is indisputable evidence of White Truck leadership.**

**Here, in open book, is the transportation history of 837 of the country's foremost truck owners—in all lines of business, all locations—operating 31,093 Whites of all models in fleets of *10* or *more*.**

**It shows an increase of 80 owners and 2,927 trucks over last year's record. Normal business changes, mergers and reorganizations have caused a few fleets to decrease and others to lose their original ownership identity.**

**In addition to the owners on the Roll Call, tens of thousands of owners operate White fleets of less than 10 or single Whites. There are more White Trucks in service than trucks of any other high-grade make.**

**These are facts—the soundest, safest guide to your own motor truck**

| | Whites Owned |
|---|---|
| Abbotts Alderney Dairies, Inc. | 56 |
| Abraham & Straus | 65 |
| Acme Cash Stores | 18 |
| J. N. Adam & Company | 38 |
| Advance Transfer Company | 14 |
| City of Akron, Ohio | 25 |
| Akron Pure Milk Company | 13 |
| Alabama Coca-Cola Bottling Co. | 14 |
| All Russia Zensky & Cities Union | 10 |
| Al's Bake Shop | 26 |
| B. Altman & Company | 85 |
| American Agricultural Chem. Co. | 26 |
| American Bakery Company | 15 |
| American Can Company | 82 |
| American Chain Company | 12 |
| American Fruit Growers, Inc. | 11 |
| American Gas and Electric Co. | 23 |
| American Ice Company | 22 |
| American News Company | 28 |
| American Petroleum Company | 29 |
| American Power and Light Co. | 35 |
| American Public Service Co. | 11 |
| American Railway Express | 457 |
| American Red Cross Society | 31 |
| American Reduction Company | 11 |
| American Steel and Wire Co. | 32 |
| American Stores Company | 121 |
| American Woolen Company | 23 |
| A. L. Ammen Transportation Co. | 48 |
| Anchor Cartage Company | 13 |
| Anderson Brothers | 16 |
| Anglo-Mexican Petrol'm Co., Ltd. | 10 |
| Anheuser-Busch, Inc. | 16 |
| State of Arizona | 58 |
| Arlington Mills | 17 |
| *Armour & Company | 405 |
| J. H. Ashdown Hdwe. Co., Ltd. | 10 |
| Associated Bell Telephone Cos. | 1183 |
| *Associated Dry Goods Corp. | 128 |
| City of Atlanta | 42 |
| Atlanta Baggage and Cab Co. | 22 |
| Atlanta Chero-Cola Bottling Co. | 10 |
| Atlanta Coca-Cola Bottling Co. | 20 |
| Atlantic Ice and Coal Corp. | 56 |
| Atlantic Refining Company | 546 |
| Atlas Powder Company | 19 |
| Austin Nichols & Company | 44 |
| Bacon Coal Company | 10 |
| The Bailey Company | 34 |
| City of Baltimore | 51 |
| L. Bamberger & Company | 44 |
| Bang Supply Company | 16 |
| Banner Grocer's Baking Co. | 12 |
| N. Bantivoglio & Sons | 10 |
| Barker Brothers, Inc. | 18 |
| *Barnsdall Corporation | 24 |
| The Barrett Company | 24 |
| W. J. Barry | 10 |
| Beaver Valley Service Company | 16 |
| Beechnut Packing Company | 13 |
| Bekins Van and Storage Co. | 19 |
| Belgrano Autobus S. A. | 10 |
| Benguet Auto Line | 10 |
| Bernheimer-Leader Stores, Inc. | 16 |
| Bessemer Taxi Company | 14 |
| Best & Company | 27 |
| B. & F. Trucking | 10 |
| William Bingham Company | 24 |
| Bingham Stage Line | 11 |
| Birmingham Chero-Cola Bot. Co. | 33 |
| City of Birmingham | 26 |
| Block & Kuhl Company | 16 |
| Bloomingdale Brothers | 41 |
| Blue Ridge Transportation Co. | 26 |
| Boggs & Buhl, Inc. | 30 |
| The H. C. Bohack Company | 16 |
| The Borden Company | 35 |
| City of Boston | 33 |
| Boston Coca-Cola Bottling Co. | 14 |
| Boston Elevated Railway Co. | 85 |
| Boulevard Transportation Co. | 20 |
| Bourne-Fuller Company | 14 |
| George H. Bowman Company | 10 |
| *Bowman Dairy Company | 22 |
| Bradford Baking Company | 47 |
| Brandies Stores | 10 |
| The Brandt Company | 41 |
| J. W. Brannon Sand and Gr'l Co. | 10 |
| Braun Lumber Company | 10 |
| John Breuner Company | 12 |
| Bridgeman & Russell Company | 17 |
| Broadway Department Store | 31 |
| Brockton Transportation Co. | 11 |
| Bronx Provision Corp. of N. Y. | 10 |
| Brooklyn Daily Eagle | 21 |
| Brooks Oil Company | 12 |
| Bry-Block Mercantile Company | 14 |
| Buckeye Pipe Line Company | 29 |
| Bullock's | 23 |
| P. H. Butler Company | 48 |
| Cable Draper Baking Company | 10 |
| Caddo Parish, Louisiana | 13 |
| State of California | 87 |
| California Baking Company | 21 |
| California Packing Corporation | 20 |
| California Petroleum Company | 18 |
| California Transit Company | 48 |
| California Truck Company | 21 |
| L. H. Callan | 10 |
| J. Calvert's Sons | 11 |
| William Cameron Co., Inc. | 11 |
| R. O. Campbell Coal Company | 12 |
| The Campbell System | 33 |
| Canfield Oil Company | 24 |
| Canton Provision Company | 17 |
| Canton Storage and Transfer Co. | 15 |
| Capitol Garage Company | 10 |
| Carbon Coal Company | 13 |
| R. E. Carey Company | 12 |
| Carolina Power and Light Co. | 11 |
| Carolina Public Service Co. | 13 |
| J. B. Carr Biscuit Company | 12 |
| Carstens Packing Company | 10 |
| Carter Oil Company | 22 |
| Casper Motor Bus Line | 11 |
| Central Maine Power Company | 11 |
| Central Torpedo Company | 12 |
| Chandler & Rudd Company | 11 |
| *Chapin-Sacks Corporation | 62 |
| Chase Bag Company | 35 |
| Cheek-Neal Coffee Company | 19 |
| *Chero-Cola Bottling Companies | 108 |
| The Chero-Cola Company | 67 |
| Chicago Am. and Herald.-Exam. | 43 |
| Chicago Fire Brick Company | 20 |
| Chicago Fire Insurance Board | 13 |
| Chicago, No. Shore & Mil.R.R. Co. | 28 |
| Chicago Towel Company | 19 |
| Chile Exploration Company | 10 |
| H. B. Church Truck Service Co. | 10 |
| Cia. Abastecedora de Leche | 10 |
| Cia. Nacional Construction | 10 |
| Cia. Tranvais de Mexico | 10 |
| Cincinnati Motor Terminals Co. | 16 |
| *Cities Service Company | 113 |
| City Baking Company | 20 |
| City of Chicago | 135 |
| City Ice Company (Kansas City) | 19 |
| City Ice and Fuel Co. (Cincinnati) | 19 |
| City Ice and Fuel Co. (Cleveland) | 19 |
| Clark Trucking Company | 12 |
| Clearing House Parcel Deliv. Co. | 13 |
| City of Cleveland | 213 |
| Cleveland-Ashtab.-Conn't Bus Co. | 18 |
| Cleveland Builders Sup. and B. Co. | 90 |
| The Cleveland Cartage Co. | 22 |
| Cleveland Coca-Cola Bottling Co. | 32 |
| Cleveland Electric Illum'g Co. | 62 |
| Cleveland-Lorain-Sand. Bus Co. | 11 |
| The Cleveland Press | 20 |
| Cleveland Provision Company | 35 |
| Cleveland Railway Company | 33 |
| Cleveland Transfer and Cart'g Co. | 33 |
| Cleveland Trinidad Paving Co. | 14 |
| Cleveland & Sandusky Brew. Co. | 30 |
| Cloverlands Dairy Products Co. | 10 |
| *Coca-Cola Bottling Companies | 353 |
| The Coca-Cola Company | 111 |
| The Coca-Cola Co., Ltd. (Canada) | 73 |
| W. I. Coldiron | 13 |
| J. C. Coleman & Son | 15 |
| Collins Hauling Company | 20 |
| Colonial Ice Cream Company | 28 |
| State of Colorado | 15 |
| Columbia Ice and Ice Cream Co. | 11 |
| Columbia Stages | 52 |
| Comar Oil Company | 23 |
| R. H. Comey Company | 11 |
| Commercial Oil Company | 10 |
| Commercial Transfer Co. | 13 |
| Commonwealth Fuel Co., Inc. | 55 |
| Commonwealth Power and L. Co. | 12 |
| The Connecticut Company | 23 |
| State of Connecticut | 67 |
| Connecticut Motor Transp'n Co. | 15 |
| Consolidated Companies | 38 |
| Consolidated Ice Company | 11 |
| Consolidated Rendering Company | 34 |
| Consort Coal Company | 11 |
| Consumers Baking Company | 20 |
| Consumers Dairy Company | 24 |
| Consumers Pie Company | 17 |
| *Continental Baking Company | 21 |
| Continental Oil Company | 123 |
| Coral Gables Utilities Company | 34 |
| Cottage Creamery Company | 14 |
| Walter J. Cox Company | 10 |
| Crane Company | 19 |
| Crescent Forward'g & Trans. Co. | 12 |
| Cuban Government | 19 |
| Cudahy Packing Company | 57 |
| John T. Cunningham | 35 |
| Cushman Sons, Inc. | 10 |
| County of Cuyahoga | 17 |
| Dahl-Campbell Grocery Co. | 15 |
| Dannemiller Grocery Company | 12 |
| Darling & Company | 26 |
| Thomas D'Attilio | 20 |
| Davison Cartage Company | 14 |
| The Dayton Company | 13 |
| De Haven Ice Cream Company | 10 |
| Denver Cab Company | 40 |
| City and County of Denver | 11 |
| Louis Des Cognets | 13 |
| Dill & Collins Company | 11 |
| Dixie Construction Company | 19 |
| Drake Brothers | 30 |
| Driscoll Trucking Company | 11 |
| East Fayette Street Bus Line | 13 |
| East Ohio Gas Company | 22 |
| East Side Mill and Lumber Co. | 15 |
| Eastern Torpedo Company | 26 |
| Eastman Kodak Company | 13 |
| Thomas W. Easton's Sons | 20 |
| T. Eaton Company, Ltd | 26 |
| Eckenroth Sales Company | 14 |
| Abraham Eisenberg Co., Inc. | 11 |
| *Electric Bond and Share Co. | 45 |
| Electric Package Agency | 14 |
| Emerick Motor Bus Company | 16 |
| Empire Baking Company | 22 |
| Empire Gas and Fuel Company | 13 |
| Ernst Fuel and Supply Co. | 11 |
| A. J. Evans | 21 |
| The Fair | 12 |
| Fair Haven Coal Company | 11 |
| Fairmont Creamery Company | 55 |
| Fayette Baking Company | 20 |
| Fenway Garage Company | 15 |
| Wm. Filene's Sons Company | 17 |
| Firestone Tire and Rubber Co. | 12 |
| Fischer Baking Company | 16 |
| Fischer Lime and Cement Co. | 10 |
| Fleischmann Company | 21 |
| Florida Coca-Cola Bottling Co. | 12 |
| Florida Motor Transport Co. | 57 |
| State of Florida | 38 |
| Fly & Hobson Company | 13 |
| C. H. Foley | 15 |
| Foster & Kleiser, Inc. | 15 |
| Frank & Seder | 35 |
| Franklin Ice Cream Company | 33 |
| Harry V. Franks | 23 |
| Frederick & Nelson, Inc. | 25 |
| William Frethofer Baking Co. | 24 |
| Fujiya Hotel Garage | 11 |
| Fuller Cleaning Company | 12 |
| W. P. Fuller & Company | 24 |
| Fullington Auto Bus Company | 13 |
| County of Fulton, Ga. | 11 |
| Frank Gaffney | 15 |
| Galena Signal Oil Company | 17 |
| A. W. Gamage, Ltd. | 14 |
| Garfield-Passaic Transit Co. | 15 |
| Gate City Dairy and Ice Cr'm Co. | 10 |
| General Baking Company | 229 |
| *General Electric Company | 22 |
| General Fire Extinguisher Co. | 11 |
| General Gas and Electric Corp. | 28 |
| General Petroleum Corporation | 94 |
| Georgia Railway and Power Co. | 62 |
| State of Georgia | 75 |
| Gerkins Oil Company | 13 |
| Gimbel Brothers, Inc. (Milwaukee) | 15 |
| Gimbel Brothers, Inc. (New York) | 94 |
| Gimbel Brothers, Inc. (Phila.) | 97 |
| Glacier Park Transportation Co. | 52 |
| Globe Grain and Milling Co. | 23 |
| Gloucester Auto Bus Company | 24 |
| City of Gloucester | 16 |
| Adolf Gobel, Inc. | 41 |
| Goeringer Construction Co. | 12 |
| Goff-Kirby Company | 18 |
| Goldenrod Ice Cream Company | 19 |
| Golden Sheaf-Remar Baking Co. | 20 |
| Golden State Auto Tours Corp. | 12 |
| Golden State Milk Products | 14 |
| J. Goldsmith & Sons Company | 12 |
| B. F. Goodrich Company | 12 |
| Goodyear Tire and Rubber Co. | 22 |
| Grasselli Chemical Company | 21 |
| Gray Construction Company | 25 |
| Grays Harbor Ry., Lt. and Pr. Co. | 12 |
| The Great Atlantic & Pacific T. Co. | 14 |
| Great Northern Paper Company | 27 |
| Great Southern Refining Co. | 11 |
| Greenfield Elec. Light and Pr. Co. | 19 |
| Greensboro Gas Company | 10 |
| Greif Brothers Cooperage Co. | 42 |
| Gridley Dairy Company | 16 |
| S. J. Groves & Sons Company | 13 |
| Gulf Production Company | 45 |
| *Gulf Refining Company | 1738 |
| Gypsy Oil Company | 30 |
| *Hadley Furniture and Carpet Co. | 16 |
| Hale Brothers | 10 |
| Halle Brothers Company | 21 |
| Hammond Lumber Company | 12 |
| W. T. Hardison & Company | 11 |
| Hardware and Supply Co. | 10 |
| Joseph Hart | 19 |
| A. D. Hartsell | 19 |
| Fred Harvey | 34 |
| C. F. Hathaway & Son | 10 |
| Hauser Packing Company | 17 |
| Haverty Furniture Company | 24 |
| Hawaii County, T. H. | 19 |
| Hawaiian Pineapple Co., Ltd. | 21 |
| Hecht Bros. & Co. | 32 |
| H. J. Heinz Company | 83 |
| Heisler & Junge Company | 20 |
| Hercules Powder Company | 17 |
| Peter Herkner Trucking Co. | 12 |
| Hershey Creamery Company | 10 |
| Hess Brothers | 11 |
| Heywood-Wakefield Company | 11 |
| Hidleah-Allattah Bus Line | 11 |
| The Higbee Company | 21 |
| Hildebrandt Provision Company | 14 |
| H. G. Hill Grocery Company | 19 |
| Hitchner Biscuit Company | 10 |
| Hochschild, Kohn & Company | 26 |
| H. B. Hole | 17 |
| Holland Bread Company | 58 |
| Hollywood Land & Water Co. of Fla. | 24 |
| Hong Kong Hotel Company, Ltd. | 11 |
| Honolulu Const. and Dray'g Co. | 14 |
| H. P. Hood & Son | 19 |
| Hope Natural Gas Company | 14 |
| Joseph Horne Company | 49 |
| Houston Lighting and Power Co. | 11 |
| Huasteca Petroleum Company | 27 |
| J. L. Hudson Company | 58 |
| Hudson's Bay Company | 22 |
| Hughes-Curry Packing Co. | 11 |
| H. B. Hughes Truck Company | 12 |
| Humble Oil and Refining Co. | 53 |
| State of Idaho | 20 |
| State of Illinois | 56 |
| Imperial Ice Cream Company | 25 |
| Imperial Oil, Ltd | 93 |
| Independent Br. Co. of Pittsburgh | 32 |
| Independent Torpedo Company | 18 |
| Independent Towel Supply Co. | 28 |
| Indian Automobile Co., Ltd | 12 |
| Indian Refining Company | 11 |
| Indian Territory Illum. Oil Co. | 12 |
| State of Indiana | 28 |
| City of Indianapolis | 11 |
| International Petroleum Co. | 10 |
| International Petrol'm Co., Ltd. | 27 |
| Interstate Public Service Co. | 12 |
| Interstate Wholesale Grocers | 27 |
| Interurban Transportation Co. | 10 |
| Iowa State Highway Commission | 32 |
| Iron City Sand Company | 22 |
| Iron Range Transportation Co. | 13 |
| County of Jackson, Mo. | 14 |
| Jahncke Service Company | 18 |
| Jefferson County (Alabama) | 42 |
| Jefferson Highway Transp'n Co. | 22 |
| Jessup & Antrim Ice Cream Co. | 11 |
| Jones Store Company | 25 |
| Julian Petroleum Corporation | 22 |
| Jump Housewrecking Company | 14 |
| S. Kann Son's Company | 15 |
| Material Cartage | 11 |
| Kansas Gas and Electric Co. | 26 |
| State of Kansas | 101 |
| Kaufmann & Baer Company | 47 |
| Herman Keiser | 11 |
| Kennicott-Patterson Trans. Co. | 11 |
| C. D. Kenny Company | 67 |
| J. Kenny Transfer Company | 15 |
| State of Kentucky | 39 |
| George Kern | 12 |
| King County (Washington) | 14 |
| Kingan & Company | 53 |
| The Knickerbocker Storage Co. | 11 |
| B. B. & R. Knight, Inc. | 11 |
| E. H. Koester Bakery Company | 21 |
| Laclede Gas Light Company | 11 |
| County of Lake (Indiana) | 11 |
| Lansburg & Brother | 15 |
| LaSalle & Koch Company | 12 |
| J. Laub Baking Company | 33 |
| Laundry Trucking Company | 10 |
| C. Lewis Lavine | 19 |
| A. Leath & Co. | 1 |
| J. William Lee | 1 |
| Lewis-Chitty Co. | 1 |
| Fred T. Ley & Co. | 2 |
| Leyte Land Trans. Co. | 3 |
| Liberty Baking | 2 |
| Lily White Gas Co. | 2 |
| Lincoln Fireproof Co. | 1 |
| Lit Brothers, Inc. | 5 |
| Livingston Bakery | 1 |
| Frederick Loesser | 3 |
| Loft, Inc. | 1 |
| Log Cabin Bakery | 1 |
| Long-Bell Lumber | 2 |
| Long's Transfer | 1 |
| J. P. Loomis Co. Co. | 1 |
| Loose-Wiles Bakery | 8 |
| Los Angeles Brewery | 2 |
| Los Angeles Creamery | 2 |
| Los Angeles Gas Corp. | 8 |
| Los Angeles Ice & Cr. Co. | 3 |
| Los Angeles Railway | 1 |
| City of Los Angeles | 2 |
| County of Los Angeles | 2 |
| State of Louisiana | 2 |
| City of Lowell | 1 |
| Louisville Railway | 1 |
| Arthur Lurie | 5 |
| Lutter Brick Co. | 1 |
| R. H. Macy & Co. | 2 |
| Magnolia Petroleum Co. | 9 |
| Mandel Brothers | 4 |
| Manhattan Oil Co. | 1 |
| City of Manila, | 4 |
| Marland Refining | 1 |
| A. C. Marshall Co. | 1 |
| Maryland State | 1 |
| State of Massachusetts | 6 |
| Massachusetts Bonding | 8 |
| Material Cartage | 1 |
| May, Stern & Co. | 5 |
| The May Company (Cleveland) | 1 |
| The May Company (Los Angeles) | 1 |
| McCreery & Co. | 1 |
| Estate of Alexander | 1 |
| McGowan Brothers | 1 |
| G. M. McKelvey | 1 |
| The C. L. McLain | 1 |
| McMahon Trans. Co. | 1 |
| McQuesten & Lee | 1 |
| L. G. Meed | 1 |
| Wm. J. Meehan | 1 |
| Memphis Power Co. | 1 |
| The Mengel Co. | 1 |
| *Mercantile Stores | 1 |
| Merchants' Transfer | 1 |
| George E. Merrill | 1 |
| Mesaba Transportation Co. | 1 |
| Metropolitan Coal | 1 |
| Metropolitan Dairy Inc. | 1 |
| Metropolitan Co. Co. | 1 |

# WHITE

# lCall

## ES OF *TEN* OR *MORE*

is the ection. Two pages of facts—in such astounding numbers as to defy nspor tation.

ar after year these great, growing institutions invest millions of dollars ntry' additional White Trucks. Their experience has taught them that they rating the *most money-earning miles* from Whites. And this valuable expe- nce is available free to anyone who will study the White Roll Call.

ecord say again, as we said in 1924 . . . no other truck manufacturer has l a few r published such a volume of evidence of uninterrupted service at tity. cost. No other truck manufacturer can.

* * *

*Let us send you free the complete White Roll Call booklet, tracing the building of these great White fleets year by year. The Roll Call has been growing steadily for 15 years. Write The White Company, Cleveland—or request it of the branch office or dealer near you.*

| | Whites Owned |
|---|---|
| h & Co | 11 |
| am Lee | 13 |
| Chitty C | 10 |
| Ley & C | 20 |
| and Tra Co | 30 |
| Baking | 28 |
| hite Gas ny | 20 |
| Firepro Co | 11 |
| thers, I | 56 |
| ton Bak y | 13 |
| ck Loes y | 35 |
| nc | 17 |
| bin Bak y | 13 |
| ell Lum y | 28 |
| Transfe | 13 |
| omis Co Co | 19 |
| Viles Bu y | 81 |
| geles Br ny | 34 |
| geles Cr pany | 27 |
| geles Ga Corp | 87 |
| geles Ice r. Co. | 30 |
| geles Ra | 17 |
| Los Ang | 22 |
| of Los A | 21 |
| Louisia | 24 |
| Lowell ( | 14 |
| le Railw y | 16 |
| Lurie | 56 |
| Brick Co | 10 |
| lacy & C | 21 |
| ia Petro ny | 97 |
| Brother | 45 |
| ttan Oil | 13 |
| Manila, | 15 |
| d Refini y | 40 |
| arshall C | 12 |
| nd State | 10 |
| Massac | 60 |
| nusetts | 85 |
| l Cartag | 18 |
| ern & C | 12 |
| y Compand) | 57 |
| y Comp eles) | 30 |
| ry & Co | 21 |
| f Alexa r | 13 |
| an Brot y | 14 |
| McKeiver | 22 |
| . McLa | 10 |
| on Tran Co | 20 |
| ten & L | 11 |
| leed | 11 |
| Meehan | 13 |
| s Power Co | 10 |
| ngel Co | 11 |
| atile Sto y | 49 |
| nts' Tra y | 20 |
| E. Merr | 31 |
| Transp pany | 19 |
| olitan Co y | 20 |
| olitan D Inc | 28 |
| olitan Ga Co | 12 |
| Metropolitan News Company | 11 |
| Metropolitan Tobacco Company | 10 |
| Mexican Gulf Oil Company | 26 |
| Louis Meyer Company | 22 |
| Mexican Petrol. Co., Ltd., of Del. | 24 |
| State of Michigan | 35 |
| Middlesex & Boston Street R. R. | 13 |
| *Middle West Utilities Corp | 22 |
| Mid-Kansas Oil and Gas Co | 10 |
| Midwest Refining Company | 26 |
| Milk Dealers Bottle Exchange | 11 |
| J. E. Miller | 23 |
| Olga Miller Trucking Company | 20 |
| Miller-Becker Company | 12 |
| Miller & Coatesworth | 10 |
| P. Milliron | 12 |
| Milwaukee Elec. Ry. and Lt. Co | 69 |
| State of Minnesota | 48 |
| State of Missouri | 31 |
| Missouri Portland Cement Co | 10 |
| State of Montana | 26 |
| Montgomery County (Ala.) | 16 |
| Henry Morgan & Company, Ltd | 14 |
| K. E. & A. K. Morgan | 38 |
| Motor Transit Company | 128 |
| The Moxie Company | 10 |
| C. F. Mueller Company | 10 |
| Murphy Transfer Company, Inc | 25 |
| A. I. Namm & Son | 68 |
| City of Nashville | 16 |
| National Bedding Company | 10 |
| National Biscuit Company | 143 |
| National Breweries, Ltd | 11 |
| National Casket Company | 29 |
| National Ice and Cold Stor. Co | 19 |
| National Ice Cream Company | 10 |
| National Lamp Works (G. E.) | 10 |
| National Refining Company | 84 |
| Neal Fireproof Storage Co | 12 |
| N. O. Nelson Mfg. Co | 11 |
| State of Nevada | 19 |
| City of Newark | 13 |
| Province of New Brunswick | 19 |
| State of New Hampshire | 18 |
| W. J. Newman Company | 15 |
| Newman Brothers | 10 |
| M. A. Newmark Company | 15 |
| New National Oil Company | 18 |
| New Orleans Pub. Service, Inc | 53 |
| City of New Orleans | 67 |
| City of New York | 711 |
| State of New York | 11 |
| New York American and Journal | 41 |
| N. Y. Board of Fire Underwriters | 21 |
| *New York Central R. R. Co | 20 |
| New York Linen Sup. & Laun. Co | 28 |
| New York State Railways | 23 |
| City of Niagara Falls | 10 |
| Noonan Bldg. Material Co., Inc | 12 |
| Norfolk Ice Delivery Corp | 10 |
| Norfolk Motor Bus Corp | 12 |
| Norak Trafik A/S | 10 |
| *North American Company | 16 |
| State of North Carolina | 77 |
| No. Shore Food Products Co | 10 |
| *Northern Ohio Trac. and Lt. Co | 84 |
| Northern States Power Company | 23 |
| Northern Transit Company | 28 |
| Northland Trans. Company | 12 |
| Province of Nova Scotia | 26 |
| Rogelio C. Novo | 10 |
| Nu-Grape Bottling Company | 23 |
| State of Ohio | 57 |
| Ohio Oil Company | 31 |
| Oil Fields Transport Company | 10 |
| State of Oklahoma | 10 |
| Oklahoma Gas and Electric Co | 13 |
| Oklahoma Pipe Line Company | 14 |
| Oliver Iron Mining Company | 12 |
| M. O'Neil Company | 13 |
| Hugh M. O'Neill | 19 |
| Onondaga County (New York) | 18 |
| Oppenheim, Collins & Co | 45 |
| State of Oregon | 40 |
| Original Stage Line | 12 |
| The Outlet Company | 15 |
| Ovington Brothers Company | 13 |
| Ozark Pipe Line Company | 20 |
| Pacific Baking Company | 34 |
| Pacific Electric Railway Co | 80 |
| Pacific Fruit and Produce Co | 22 |
| Pacific Gas and Elec tric Co | 36 |
| Pacific Mills | 25 |
| Pacific Oil Company | 16 |
| Palais Royal | 17 |
| Pan American Petroleum Co | 20 |
| *Pan American Petr. and Tr. Co | 58 |
| Park Auto Transportation Co | 12 |
| Park & Tilford | 13 |
| Parker Brothers, Ltd | 22 |
| Frank Parmalee Company | 20 |
| Paterson Brew. and Malting Co | 10 |
| Pechter Baking Company | 11 |
| Peninsula Rapid Transit Co | 28 |
| State of Pennsylvania | 21 |
| Pennsylvania Edison Company | 12 |
| Pennsylvania Electric Corp | 13 |
| *Pennsylvania-Ohio Elec. Co | 38 |
| Peoples Gas Light and Coke Co | 14 |
| Perrett & Glenney | 13 |
| D. Peters | 14 |
| Petroleum Heat and Power Co | 13 |
| Philadelphia Electric Company | 16 |
| City of Philadelphia | 11 |
| Philippine Government | 53 |
| Phenix Cheese Company | 14 |
| Phoenix Utility Company | 25 |
| Pickwick Stages | 12 |
| M. H. Pickering Company | 10 |
| Pierce Petroleum Corporation | 225 |
| Piggly Wiggly Stores | 45 |
| Pike's Peak Auto Highway Co | 17 |
| Pilsener Brewing Company | 15 |
| Pioneer Truck Company | 15 |
| Pittsburgh Gage and Supply Co | 14 |
| Pittsburgh Mercantile Company | 13 |
| Pittsburgh Plate Glass Company | 27 |
| H. & S. Pogue Company | 19 |
| Portland Sebago Ice Company | 14 |
| Postal Telegraph Cable Co | 10 |
| Powers Mercantile Company | 12 |
| Prairie Oil and Gas Company | 33 |
| Prairie Pipe Line Company | 71 |
| City of Providence | 10 |
| Providence Journal Company | 10 |
| Public Service Co. of Colorado | 23 |
| Public Service Corp. of N. J | 13 |
| Public Service Electric Company | 86 |
| Public Service Gas Company | 26 |
| Public Service Production Co | 15 |
| Public Service Transport'n Co | 81 |
| Puget Sound Intern'l Ry. & P. Co | 11 |
| Puget Sound Power and Light Co. | 27 |
| *Pure Oil Company | 28 |
| *Purity Baking Company | 35 |
| Purtell Brothers | 14 |
| Puyalup-Tacoma Transit Co | 23 |
| Quaker City Cab Company | 151 |
| Queens Bus Line Company | 33 |
| City of Quincy | 10 |
| Rainier National Park Company | 29 |
| Range Bus Line | 11 |
| Red Rock Company | 12 |
| T. S. Reed Grocery Company | 10 |
| Reed Oil Corporation | 10 |
| Reinhold Ice and Ice Cream Co | 15 |
| Republic Structural Iron Wks. Co. | 13 |
| Rhodes Wood Furniture Co | 11 |
| Frank G. Richards | 23 |
| Richfield Oil Company | 41 |
| RichmondRapid TransitCompany | 20 |
| Ridgewood Pie Baking Company | 10 |
| Rieck-McJunkin Dairy Company | 79 |
| City of Rio de Janeiro | 10 |
| Rio Grande Oil Company | 20 |
| River Auto Stage Line | 18 |
| Rochester Gas and Electric Co | 49 |
| Rocky Mountain Parks Trans. Co. | 95 |
| L. W. Rogers Company | 18 |
| Rome Coca-Cola Bottling Co | 11 |
| The Rosenbaum Company | 48 |
| B. Rosenberg Company | 13 |
| *Roxana Petroleum Corporation | 289 |
| *Royal Dutch Company | 20 |
| Fred Rusch | 25 |
| George Rushton Baking Co | 11 |
| J. P. Ryan | 12 |
| Saginaw Transit Company | 10 |
| City of St. Louis | 15 |
| St. Louis Bus Company | 13 |
| City of St. Paul | 17 |
| Saks & Company | 40 |
| Salt Lake Transportation Co | 25 |
| San Diego Consol. Gas & El. Corp. | 20 |
| Santo Domingo Pub. Wks. Dept | 31 |
| City and County of San Francisco | 42 |
| San Francisco Motor Drayage Co | 11 |
| San Francisco Municipal Railway | 12 |
| Sanger Brothers | 10 |
| Sanitary Grocery Company | 10 |
| San Joaquin Baking Company | 17 |
| San Joaquin Lt. and Power Corp. | 22 |
| Santa Ana Commercial Co | 15 |
| City and County of Santa Barbara | 10 |
| S. R.-P. & S. Auto Stage Co | 13 |
| Morris Schapiro Interests | 11 |
| Schmidt & Ziegler, Ltd | 10 |
| Schulze Baking Company | 56 |
| Henry Schultz | 11 |
| Nathan Schweitzer Co., Inc | 11 |
| George Scofield Company | 15 |
| Scott Transportation Company | 18 |
| S. & E. Motor Hire | 17 |
| City of Seattle | 17 |
| Seattle Transportation Co | 14 |
| Semon Ice Cream Corporation | 10 |
| Seven Baker Brothers | 41 |
| Shaeffer-Black Company | 19 |
| Shaffer Oil and Refining Co | 63 |
| Sharpless-Hendler Ice Cream Co | 20 |
| Dennis Sheen Transfer Company | 22 |
| Shell Oil Co. of California | 176 |
| Shepard Norwell Company | 11 |
| Sherman, Clay & Company | 14 |
| John Shillito Company | 19 |
| Shults Bread Company | 18 |
| Sieloff Packing Company | 15 |
| Franklin Simon & Company | 27 |
| Sinclair Consolidated Oil Corp | 23 |
| Skelley Oil Company | 16 |
| Lonie Slacum | 10 |
| W. & J. Sloane | 37 |
| Sonoma County, California | 13 |
| State of South Carolina | 25 |
| State of South Dakota | 18 |
| Southeastern Express Co | 169 |
| Southern Dray Company | 10 |
| Southern Oil Corporation | 12 |
| Southern Pacific Company | 11 |
| Southern Sierra Power Co | 11 |
| Southern Utilities Company | 12 |
| W. P. Southworth Company | 15 |
| Spear & Company | 23 |
| Sperry Flour Company | 17 |
| City of Springfield, Mass | 11 |
| Stadler Products Company | 13 |
| Otto Stahl, Inc | 22 |
| Standard Brewing Company | 12 |
| Standard Oil Co. of Brazil | 13 |
| Standard Oil Co. of California | 256 |
| Standard Oil Co. of Indiana | 234 |
| Standard Oil Co. of Kentucky | 465 |
| Standard Oil Co. of Louisiana | 207 |
| Standard Oil Co. of Nebraska | 28 |
| *Standard Oil Co. of New Jersey | 193 |
| Standard Oil Co. of New York | 842 |
| Standard Oil Co. of Ohio | 162 |
| Standard Pipe Line Company | 18 |
| Standard Sanitary Mnfg. Co | 46 |
| State Construction Company | 14 |
| C. P. Steinheiser Company | 10 |
| Sterchi Brothers | 20 |
| Sterling & Welch Company | 20 |
| Stern Brothers | 48 |
| John Sternecker | 72 |
| Steubenville Coal and Min'g Co | 11 |
| Steub., E. L. & B. V. Traction Co | 21 |
| Stewart & Company | 22 |
| Stoll Oil Refining Company | 15 |
| *Stone & Webster Interests | 72 |
| Strawbridge & Clothier | 34 |
| Stringfellow-Harman Co | 12 |
| Stoehmann Baking Company | 25 |
| Stryker Transport'n and Cont. Co. | 12 |
| Summerfield Company | 14 |
| Sun Oil Company | 65 |
| Superior White Company | 10 |
| Tacoma Bottling Works | 17 |
| Taft-Kern Co. (Cal.) School Dist | 15 |
| Taylor Bros. & Paquet Co | 15 |
| Wm. Taylor, Son & Company | 36 |
| Teche Transfer Company | 34 |
| Telling-Belle Vernon Company | 97 |
| State of Tennessee | 11 |
| Tennessee Electric Power Co | 10 |
| Terre Haute Brewing Company | 13 |
| State of Texas | 65 |
| Texas Company | 188 |
| Texas Power and Light Co | 13 |
| Textile Machine Works | 10 |
| Theurer Norton Provision Co | 16 |
| Thomas Bennett & Hunter | 19 |
| Tidal Oil Company | 19 |
| *Tide Water Oil Company | 63 |
| Tide Water Oil Sales Corp | 11 |
| City of Tokyo, Japan | 19 |
| Tokyo Shigai Jidosha Company | 65 |
| City of Toronto, Ont., Canada | 11 |
| Transcontinental Oil Company | 41 |
| Tribune Pub. Co. (Oakland) | 10 |
| Trigg-Dobbs & Company | 11 |
| Twin City Motor Bus Company | 33 |
| Union Auto Transportation Co | 12 |
| Union Electric Lt. and Power Co | 11 |
| Union Gas and Electric Co | 40 |
| Union Ice Company | 26 |
| Union Oil Co. of California | 759 |
| Union Transfer Co. (Fremont) | 12 |
| Union Transfer Co. (Phila.) | 13 |
| Union Wholesale Lumber Co | 12 |
| Uniontown Baking Company | 10 |
| United Drug Company | 10 |
| United Electric Light Company | 12 |
| United Electric Railways Co | 34 |
| *United Gas Improve.Co.Interests | 62 |
| United Natural Gas Company | 12 |
| United Railways and Elec. Co | 35 |
| United Service Company | 12 |
| United Shoe Machinery Corp | 14 |
| United Stage Lines | 12 |
| United States Bakery | 28 |
| United States P. O. Dept | 659 |
| United States Rubber Company | 17 |
| *United States Steel Corp. Ints | 27 |
| United States Stores Corp | 14 |
| Updike Lumber and Coal Co | 13 |
| Utica Gas and Electric Company | 28 |
| Vacuum Oil Company | 27 |
| A. Valdes & Company | 13 |
| State of Virginia | 74 |
| Viscose Company | 17 |
| F. G. Vogt & Sons, Inc | 11 |
| Waite Phillips Company | 14 |
| John Wanamaker | 99 |
| Ward Baking Corporation | 24 |
| Warner Sugar Refining Co | 12 |
| Washington Bakeries Corp | 43 |
| Washington Railway and El. Co | 27 |
| County of Wayne, Michigan | 10 |
| Webb, Hendricks & Hamilton | 12 |
| Welcker Trans. and Storage Co | 11 |
| Raphael Weill & Company | 20 |
| Percy Wenham | 14 |
| West Penn System | 41 |
| West India Oil Company | 27 |
| State of West Virginia | 22 |
| Western Electric Company | 10 |
| Western Newspaper Union | 27 |
| Western Meat Company | 39 |
| Western Motor Transfer Co | 17 |
| Western Union Telegraph Co | 11 |
| Westinghouse Elec. and Mfg. Co | 15 |
| Wheeling Steel Corporation | 23 |
| R. H. White Company | 13 |
| White Stage Line | 24 |
| White Transfer & Storage Co | 13 |
| White Transit Company, Inc | 52 |
| Whiting-Mead Commercial Co | 16 |
| W. A. Wieboldt Company | 25 |
| Willard's Chocolates, Ltd | 14 |
| Wilshire Oil Company | 16 |
| Wilson & Company | 30 |
| Winchester Laundry Corp | 29 |
| Wm. Winkler (Steele-Wedeles) | 20 |
| Winona Oil Company | 14 |
| State of Wisconsin | 27 |
| Wisconsin Power and Light Co | 10 |
| Wise Brothers | 21 |
| Wofford Oil Company | 30 |
| Wood River & Alton Bus Lines | 10 |
| Woodward & Lothrop | 22 |
| Woolner Brewing Company | 11 |
| City of Worcester (Mass.) | 13 |
| Worden & Son | 14 |
| Geo. Worthington Company | 19 |
| Wouter's Laundry | 12 |
| Wright Cake Company | 17 |
| State of Wyo ming | 30 |
| C. H. Yeager Company | 10 |
| Yellowstone Park Transp'n Co | 304 |
| Yosemite National Park Co | 52 |
| Youngstown Municipal Ry. Co | 36 |
| Youngstown Sheet & Tube Co | 12 |
| Ypsilanti Reed Furniture Co | 11 |
| Zamboanga Transportation Co | 19 |
| Zellerbach Paper Company | 13 |
| Zetteimeyer Coal Company | 22 |
| Zions Co-op. Mercantile Inst | 11 |
| | 31093 |

# E TRUCKS

* Exclusive of subsidiary or affiliated comoanies individually listed.

THE WHITE COMPANY
CLEVELAND

# Recently Patented Inventions

*As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.*

### Pertaining to Aeronautics

HELICOPTER.—Of the captive type, of light construction but having sufficient power to carry up several persons. Patent 1523926. H. Ypma, 2312 Thompson St., Los Angeles, Calif.

SEMIRIGID AIRSHIP.—In which the lower frame comprises hinged rigid sections, a plurality of catenaries connecting vertical ropes, and fastened at their ends to each of said sections. Patent 1526120. G. A. Crocco, c/o L. Laboccetta, Via Due Macelli 31, Rome, Italy.

AIRSHIP.—Wherein vacuums are employed to produce the buoyancy, and the use of dangerous gases is obviated. Patent 1526,-927. E. A. Oliver, Richland, Mo.

### Pertaining to Apparel

CORSET.—Constructed to eliminate the usual contraction of the body, yet to retain the back in straight line, and hold the bust firmly. Patent 1525325. L. S. Schuman, 954½ Westchester Ave., New York, N. Y.

SUSPENDERS.—Whereby the length of the suspenders may be adjusted without positioning any part of the fastening means against an underlying garment. Patent 1526476. E. Hodaly, Box 339, Inspiration, Ariz.

HATBAND.—Which reduces approximately fifty percent of the pressure on the head, minimizing the interference with blood circulation. Patent 1528220. J. B. Leighton, The Hemlocks, Hastings-on-Hudson, N. Y.

REVERSIBLE CUFF.—That may be folded one way to simulate a plain cuff, and the opposite way to simulate a turnover cuff. Patent 1528677. L. I. Lipton, 47 Leonard St., New York, N. Y.

ONE-PIECE COAT.—Which will use a minimum amount of material and may be laid out to produce a correctly formed coat. Patent 1530310. M. V. Dorsi, 3916 Ave. D, Brooklyn, N. Y.

DIAPHRAGM SUPPORT.—In the form of a band which co-acts with a corset, and is held against upward or downward movement. Patent 1530446. I. K. Watts, c/o Courtland Palmer, 26 Broadway, New York, N. Y.

### Chemical Processes

COMPOSITION FOR USE IN THE REPRODUCTION OF LINE DOCUMENTS.—Such as line drawings and tracings, the composition comprises gelatin, glycerine, light oxide of zinc, nickel sulphate and water. Patent 1521509. J. Dorel, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

### Electrical Devices

ELECTRIC HEATER.—Wherein the heating coil is disposed within a closed casing, in the general form of a steam heat radiator. Patent 1524993. T. F. Meinhardt, G. I. and G. G. Ray, c/o George I. Ray, 311 E. 5th St., Charlotte, N. C.

ELECTROPLATING BARREL.—Constructed in such manner that the electrolytic current is most efficiently achieved, and distributed. Patent 1525271. J. T. Daniels, 188 Lincoln Ave., Newark, N. J.

ELECTRICALLY-DRIVEN PERIODICALLY-MOVING MECHANISM.—For use in connection with principal clocks, auxiliary clocks, and rocking devices for advertisement apparatus, etc. Patent 1527140. C. D. J. Jamin, Jr., c/o Nederlandsch Octrooi-Bureau, 31 Laan Copes Van Cattenburch, S Gravenhage, Holland.

TESTING-UNIT ATTACHMENT FOR FLASH LIGHTS.—By means of which the lamp may be used for testing various circuit faults, in the usual manner. Patent 1528709. C. R. Trimble, 249 W. 111th St., New York, N. Y.

SUSPENSION APPARATUS FOR ELECTRIC HAIR CLIPPERS.—Adapted to be secured to a ceiling, and be flexible, to permit of being automatically raised or lowered. Patent 1528005. L. A. Cannaday, Fairburn, Ga.

ELECTRIC HEATER.—For liquids, having an exceedingly high heating capacity at a low consumption of current. Patent 1529200. J. F. Mercer, Box 56, Globe, Arizona.

ELECTRIC ALARM APPARATUS.—Designed to act as a protection against burglary and fire. Patent 1530419. G. Schmidt and C. Boker, c/o R. H. Trenka, 144 Violet Ave., Floral Park, L. I., N. Y.

TRANSFORMER ECONOMIZER.—For disconnecting the primary of a transformer from the line to prevent core loss therein when the load is removed from the secondary. Patent 1529711. C. W. Parrott and O. N. Hesselmann, c/o O. L. Hesselmann, 1734 Bennett St., Dubuque, Iowa.

### Of Interest to Farmers

DEVICE FOR APPLYING POISON.—Particularly adapted for use in treating cotton plants for the killing of boll weevil. Patent 1527669. T. Camp, 37 Norcross St., Atlanta, Ga.

PROCESS AND APPARATUS FOR ELIMINATING ONION SEEDS FROM GRAIN.—Such as wheat, barley and oats, prior to the grinding of the grain. Patent 1528009. H. J. Daniel, Southerlin, Va.

PRUNE PICKER.—Which will facilitate the picking up of prunes in quantity and save hand labor. Patent 1528241. H. L. Berberich, 895 Monterey St., Hollister, Calif.

### Of General Interest

CARBOY.—Having lateral supporting members giving strength and resiliency, which may be easily replaced if broken. Patent 1524564. C. Lefkowitz, c/o Hercules Carboy & Box Co., 35 South St., Newark, N. J.

SPOOL.—Relating to the head and fastener for the same, wherein the head is firmly locked in place, yet capable of removal. Patent 1524204. C. D. Ordway, c/o Vermont Spool & Bobbin Co., Burlington, Vt.

FILTER.—Including one or more filtering layers, for mounting in a funnel, with means for allowing the escape of air. Patent 1524-547. S. A. Giacobbe, 887 Park Ave., New York, N. Y.

METHOD OF PRODUCING REMADE PICTURES.—Which affords wide liberty in retouching, etching chemically reducing locally, or otherwise altering the image of motion pictures. Patent 1524276. B. F. Puffer, 169 Brampton Road, Garden City, L. I., N. Y.

PACKAGE CARRIER.—Involving two carrier bars with gripping means, so that the package may be carried by two persons in tandem. Patent 1525383. C. Haarberg, R. F. D. No. 1, Box 57, Kent, Wash.

TUBULAR EXTENSION NIPPLE FOR BABIES' BOTTLES.—Extending downwardly into the bottle, so the milk can be obtained even when the bottle is not fully tilted. Patent 1525314. G. B. Mullen, Bell Ave., Bayside, L. I., N. Y.

DISPLAY CASE.—More particularly for umbrellas, parasols, and the like, whereby a large number may be shown. Patent 1525,-330. G. A. Smith, 481 Barrington St., Halifax, N. S.

BOX OR CONTAINER.—In the form of a book, especially adapted for containing confections and the like. Patent 1525321. F. M. Pike, c/o Mount Mansfield Maple Merchant, Stowe, Vt.

INTERLINE-TICKET CASE.—Intended to accommodate thin tickets of widely different lengths which are held suspended ready to be grasped. Patent 1525318. O. S. Payzant, Room 2615, Grand Central Station, New York, N. Y.

RETAINER FOR OVERSHOES.—Which is effective to securely fasten the rubber, and prevent its slipping off even in heavy mud. Patent 1524805. H. C. Anderson, Stanford, Ky.

PROCESS OF PREPARATION OF PEARL ESSENCE.—Whereby fish scales and various animal tissues or waste portions may be made a source for producing pearl essence. Patent 1525317. J. Paisseau, 53 Rue de Chateaudun, Paris, France.

BOX AND COVER.—With an improved means for connecting the body and the cover.

## News for Inventors

*A Department of Facts and Notes of Interest to Patentees and to Owners of Patent and Trademark Rights*

Conducted by Milton Wright

### An Inventor Who Delayed

ALTHOUGH the Pennsylvania Railroad Station in New York was completed in 1913, the court has just ruled that work on the structure was not experimental.

The decision is handed down by the United States Circuit Court of Appeals in California. It involves imitation travertine stone, now so widely used.

The inventor, Paul E. Denivelle, installed the work in the Pennsylvania Station in 1910. Five years later he applied for a patent. The material became extremely popular and he procured injunctions against alleged infringers.

To the contentions of the defendants that his public use and sale of his invention more than two years prior to his application rendered his patent invalid, Denivelle replied that the work on the Pennsylvania Station was an experiment. Despite the fact that the same court had upheld his patent before, further evidence showed the patent invalid.

### A Million Dollar Idea

YEARS ago in a Maine lumber mill a fifteen-year-old boy named John Spencer observed a rounded cleanout door which constantly was changing shape with a loud snap. It would bulge out and then in, as it was influenced by the change in heat.

Years later Spencer harked back to that snapping cleanout door. He started a series of experiments and worked out a formula for a combination of metals best suited for his purpose.

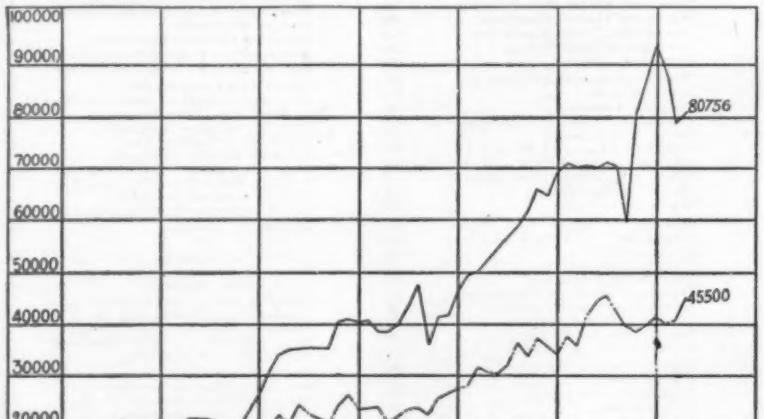
Recently he sold his invention for more than $1,000,000. The device will revolutionize electric heating apparatus.

### A New Use for An Old Idea

HOW a leading industry is revolutionized and hundreds of thousands of dollars saved annually through using an old and simple idea in a new way is excellently illustrated in the victory of George Lane over the Craftsman Film Laboratories, Inc., recently upheld by the Circuit Court.

Lane, the manager of the motion picture title department of the Universal Film Company, grew dissatisfied with the prevailing method of photographing titles, which resulted all too often in blurred letters and off shades of black background. He conceived the idea of using the old process of sun copying, or exposing to the sun, letters printed on tissue paper in close contact with sensitized paper. The result was perfect printing of titles for the first time and production by one man of 100 to 200 titles a day instead of a maximum of fifty.

When one recalls that the cost of printing titles by the old method was twenty-five to fifty cents each, that there are twenty-five to thirty titles in the average reel and that hundreds of thousands of reels are made every year, some appreciation of the value of Lane's patent may be reached.




ARE WE RUNNING OUT OF IDEAS?

*Not according to this graph showing how patents have increased since the Civil War. The lower line records patents applied for, the upper line patents issued. Note how close the two lines are together in 1864 and how far apart last year. Can you explain the spread?*

### "Cop Spotters"

CAN a man register the trademark "Cop-Spotter" for a device by which autoists can tell whether or not they are being followed by motor-cycle policemen?

No, says Assistant Commissioner Fenning. His decision in aid of speeds is based on the principle that the mark is descriptive of the goods.

"The evidence clearly indicates," rules Commissioner Fenning, "that one use made of mirrors on automobiles is to observe whether or not an automobile is being followed by a traffic policeman. These individuals are colloquially referred to as 'cops' and the act of observation is colloquially referred to as 'spotting.' It seems clear, therefore, that the instrument as employed in the observation of a policeman is aptly described in colloquial terms as a 'cop spotter.'"

applicable to cigar, and similar boxes. Patent 1526213. C. S. Humphrey, 95 86th St., Brooklyn, N. Y.

CORNER CLIP.—For reinforcing the corners of pocketbooks, wallets and the like, and presenting an ornamental appearance. Patent 1526261. M. A. Wachs, 33 Bleecker St., New York, N. Y.

MAIL CARRYING AND DISTRIBUTING DEVICE.—Particularly adapted to the carrying, distributing and protection of rural mail. Patent 1526122. O. Dau, Yutan, Neb.

POLISHING AND CLEANING MITTEN.—Which may be worn on the hands as cleaning or polishing mittens, or as an article of clothing. Patent 1526175. W. L. Ochs, 623 W. 20th St., New York, N. Y.

WRIST AND HAND BAG.—So arranged that the pocket structure will function when the bag is either clamped to the wrist, or depending. Patent 1526245. W. Simek, 75 24th St., Guttenberg, N. J.

FOLDING PAPER BOX.—Constructed from a single sheet of material, and locked, when assembled. Patent 1525687. E. N. Owens, P. O. Box 938, Wichita, Kansas.

POWDER EJECTOR.—Which is effective to forcibly spray powder while protecting and maintaining the powder in a dry state. Patent 1526096. C. E. Sims, Gorman, Texas.

COLLAPSIBLE BOX.—Insuring a proper circulation of air to the eggs, fruit or other foodstuffs, which may be packed therein. Patent 1524966. G. Boelman and A. L. Paterson, R. F. D. No. 1, Box 1, Oroville, Calif.

COMBINATION CANE AND HANDBAG.—Adapted to be used as a handbag alone or in connection with a cane, umbrella or other support. Patent 1526246. W. Simek, 75 24th St., Guttenberg, N. J.

COOKING AND SERVING RECEPTACLE.—Having individual serving dishes, containing a separate portion of pie, pudding or other cooked foods, without impairing the other portions. Patent 1526397. A. L. Thornton, Box 559, El Paso, Texas.

PERCOLATOR.—Including a device for forcing liquid remaining in the container into the bottom of the percolator, thus obtaining additional liquor. Patent 1526745. A. P. English, 1647 Main St., Jacksonville, Fla.

TAKEDOWN TABLE.—Consisting of a minimum number of interlocking parts which may be readily assembled to form a rigid structure. Patent 1527094. G. E. Tomlinson, Winchester, Ky.

EDUCATIONAL BLOCKS.—More particularly the invention aims to provide a device for teaching the principles of parliamentary law in a simple manner. Patent 1527051. E. L. Longan, 401 Waldheim Bldg., Kansas City, Mo.

VANITY CASE.—With a plurality of sections, each section forming compartments presenting mirrors and cosmetics. Patent 1527052. Mary V. McAndrews, 419 100th St., Brooklyn, N. Y.

CAKE TRAY AND COOLER.—On which a cake may be placed after baking, for cooling or storage. Patent 1527141. Anna M. and G. R. Kirkpatrick, c/o John M. Kirkpatrick, West Lafayette, Ohio.

LOCK FOR CLOSURE CAPS.—For locking the outlet of petrol or other tanks, so that the contents cannot be drawn off. Patent 1527036. R. Elcock, c/o D. M. Kisch & Co., 16 National Mutual Bldg., Johannesburg, Transvaal, So. Africa.

CORN AND BUNION PAD.—Which will neatly and snugly fit over any uneven surface without undue pressure, and will retain its position. Patent 1527009. F. H. Plate, 10135 118th St., Richmond Hill, L. I., N. Y.

INTELLIGENCE-TESTING APPARATUS.—In which a series of movable devices, registering within a space, will indicate the answer to a problem. Patent 1527126. S. C. Dodd, Princeton, N. J.

BRIDGE.—Especially intended for use at places where highways cross ditches or creeks, which require frequent dredging. Patent 1526359. R. G. Michie, Montevideo, Minn.

TOOTHBRUSH.—Of folding form, thereby enabling the brush to be made into a compact article for convenient carriage in the pocket. Patent 1527853. W. Ferdon, 5425 Pasco, Kansas City, Mo.

PRINTING DEVICE.—So constructed that it may be used for marking on a flat surface or a barrel, bag or bale. Patent 1527921. E. R. Rodriguez, c/o Auto Mark Corp., 48 Stone St., New York, N. Y.

PENCIL HOLDER.—Which will firmly clasp a short length of pencil, and prevent vibration while writing. Patent 1527851. R. J. Estes, Coalgate, Okla.

CLOSURE FOR CABINETS AND THE LIKE.—In the form of a flexible closure for kitchen cabinets, which may be detached when adjusted to a predetermined position. Patent 1527865. A. V. Guiss, c/o Coppes Bros. & Zook, Nappanee, Ind.

TOILET SYSTEM FOR VESSELS.—In which water is pumped to and from the bowl to effectively flush the same and prevent clogging. Patent 1527841. A. Christen, c/o Consolidated Shipping Corp., Morris Heights, New York, N. Y.

PENCIL.—So constructed that it will contain a plurality of leads, adapted to be successively brought into use. Patent 1528687. J. R. and F. R. Nyman, 302 So. F St., Aberdeen, Wash.

MINNOW BUCKET.—Which is extensible, convenient of access, and which will safely confine the live bait in a swiftly flowing stream. Patent 1528465. C. D. Burbank and J. Reichert, Main St., Henderson, Ky.

TREE PROTECTOR.—Whereby caterpillars, Argentine ants, and crawling insects may be prevented from passing a given point upon the trunk of a tree. Patent 1528663. J. Fernandes, Jr., 305 Orme Bldg., New Orleans, La.

FOLDING TABLE.—Adapted to be folded into a compact unitary structure and stored in a small space. Patent 1528156. F. C. Lewis, 63d St. and Central Park West, New York, N. Y.

CARRYING CASE.—Which houses a flask and drinking receptacles, and protects the same against accidental breakage. Patent 1528680. A. Marcor, Jr., c/o Southern Pacific R.R. of Mexico, Cananea, Mexico.

JEWELRY TAG.—Readily applied by the fingers, and constructed of celluloid or washable material. Patent 1528720. C. T. Wittstein, c/o Arch Crown Mfg. Co., Warren and Arch Sts., Newark, N. J.

PIPE STEM.—The "bit" portion being so formed that it will prevent the concentration of a stream of smoke upon the tongue. Patent 1527943. C. H. Weiss, 1023 State St., Quincy, Ill.

HORN.—Of wood, adapted for use in connection with phonographs, radio receiving sets or the like. Patent 1526819. G. Amoroso, 157 Winfield St., San Francisco, Calif.

PEANUT BUTTER.—So formed that it will remain in a semi-solid state when exposed to the temperature of an ordinary room. Patent 1528077. J. L. Rosenfield, 1916 Webster St., Alameda, Calif.

SUGAR CONTAINER.—In which sugar can be stored so that the tendency to lump in moist atmosphere will be eliminated. Patent 1528927. J. Kaplan, 380 Thames St., New York, N. Y.

REFRIGERATING APPARATUS.—For embodiment in a display counter, with means for maintaining a low temperature and a circulation of dry air. Patent 1528860. C. C. Taylor, Oak St., Mounds, Ill.

## Hardware and Tools

FRICTION GRIP WRENCH.—Designed as a tool for facilitating the removal of headlight rims, and adjustable to rims of various sizes. Patent 1525358. G. W. Bergen, 613 F St., Belmar, N. J.

SAFETY LATCH HOOK.—Having movable means for closing the passage between the point of the bill and the shank. Patent 1524844. A. R. Scott and F. C. Lidel, 948 Milwaukee Ave., Portland, Ore.

COMBINED SCRAPING AND FINISHING PLANE.—Having simple means for holding blades of various widths, and adjusting the same to produce the desired cut. Patent 1525003. E. J. Sharadin, 1239½ Sunset Blvd., Los Angeles, Calif.

TRAP.—In which spring means is employed to urge the jaws to their closed position, instantly killing the animal. Patent 1527034. H. Durrin, c/o David West, Lake George, N. Y.

TOOL SUPPORT FOR LATHES.—So constructed that the height of the cutting edge, and the angle of the tool, may be quickly adjusted. Patent 1526849. J. F. Grabill, Flora, Ill.

FISHING TOOL.—Designed to work effectively in the recovery of long or large objects in deep cavings. Patent 1526412. C. H. Brown, c/o Brown Welding and Machine Co., Breckenridge, Texas.

PERMUTATION LOCK.—Of simple construction, but practically incapable of being opened by feeling for the gates forming the combination. Patent 1527035. R. Elcock, c/o D. M. Kisch & Co., 16 National Mutual Bldg., Johannesburg, Transvaal, So. Africa.

MINING BIT.—Which cannot become accidentally disengaged, and is capable of use in either right or left-hand drilling machinery. Patent 1526565. J. E. Redmond, 852 South Main St., Butte, Mont.

LOCK.—With swingable shackle, locked in position by a bolt actuated by a spring, and unlocked by a spirally threaded key. Patent 1526728. J. S. Wagner, Diamondville, Wyo.

COMBINED POKER AND CLINKER TONGS.—An implement hardly larger than an ordinary furnace poker, yet combining the qualities of both tools. Patent 1526517. C. E. Voght, Houghton, Mich.

CHOKER HOOK.—Designed for use in hoisting and conveying logs, and having a swivel connection to permit the parts to freely move. Patent 1525753. E. Law, Pe Ell, Wash.

DOOR OPENING AND CLOSING DEVICE.—Including controlling connections for oppositely swinging spring actuated doors, to constrain the doors to simultaneous opening and closing movements. Patent 1527077. C. A. Purvis, Versailles, Mo.

ANIMAL TRAP.—So constructed that the jaws co-operate to dislodge and prevent small objects from hindering the complete closing of the trap. Patent 1527891. D. Lovelace, c/o Lovelace Mfg. Co., Clinton, Okla.

FISHING TOOL.—Adopted for use in recovering broken sucker rods and the like, and is characterized by the absence of toothed slips. Patent 1527499. B. Woods, 420 W. 3rd St., Tulsa, Okla.

## Heating and Lighting

SUPERHEATER FOR HOT-WATER HEATING SYSTEMS.—In which the gases of combustion supply additional heat to the water on its way from the boiler to the radiator. Patent 1525199. L. J. Rees, Lincoln, Kansas.

BURNER OR PREHEATING TORCH.—Which efficiently generates its own fuel gas from kerosene or similar hydrocarbons, and is readily controlled. Patent 1524832. W. A. McCoy, Jr., McCoy, Texas.

FURNACE DOOR.—Equipped with means for injecting into the combustion chamber a plurality of jets of partially heated air. Patent 1526279. J. T. Haeusser, Box 116, West Albany, N. Y.

LIQUID-FUEL HEATER.—Adapted for installation in the fire box of a steam, hot water or hot air furnace, to take the place of coal. Patent 1526227. J. J. Lauster, 133 Gatling Place, Brooklyn, N. Y.

FURNACE STRUCTURE.—In which the products of combustion will heat the outer surface of the furnace and maintain a higher temperature, before passing out of the chimney. Patent 1527153. A. Gray, 170 Woodworth Ave., Yonkers, N. Y.

INSULATED CASING.—For furnaces, constructed of interfitting sheet metal and asbestos panels, adapted to be readily bolted together. Patent 1527679. N. Frost, c/o Am. Foundry and Furnace Co., Bloomington, Ill.

FIRE BRICK FOR FURNACE WALLS.—Constructed to prevent the expansion and contraction of the furnace walls and the formation of clinkers thereon. Patent 1529183. C. D. Howren, 244 W. 27th St., Norfolk, Va.

FUEL-OIL BURNER.—Relating particularly to gaseous burners for oil-burning furnaces employing kerosene or other oil distillates. Patent 1529821. M. W. Wood, 2225 E. 3d St., Sioux City, Iowa.

## Machines and Mechanical Devices

HYDRAULIC SIPHONING MACHINE.—For forcing water to a higher level by the power developed by the pressure of the source of water. Patent 1524989. T. L. McMinn, R. No. 4, Oxford, Ala.

BREAST-WHEEL SANDER.—Providing means for holding the emery paper or cloth, in such manner that the life of the sheet is materially prolonged. Patent 1525391. E. A. Iacoponelli, Box 135, Natchez, Miss.

COIN GUIDE.—Particularly adapted to turnstile coin boxes, for guiding a coin to enter the drop unerringly. Patent 1524747. R. T. O'Connell, Mamaroneck, N. Y.

SELF-LOCKING WASHER.—Adapted to be placed on a bolt, or piston rod, without its being necessary to remove the same from a support. Patent 1524817. F. H. Day, 309 "F" St., N.E., Washington, D. C.

COTTON PICKER.—Which may be moved along the rows of plants, which is adjustable, and will automatically remove the cotton-bolls. Patent 1525670. W. A. So Relle, c/o Spearman Lands, Clarendon, Texas.

CENTRIFUGAL PUMP.—Having means for sealing the front, preventing leakage between the impeller shaft and the adjacent parts. Patent 1525884. H. G. Plummer, 6064 Charlot Road, Oakland, Calif.

TAKE-UP GUIDE FOR SHUTTLES.—Wherein the thread is automatically brought into contact with the take-up as it moves to its proper threaded position in the guide. Patent 1526237. J. Rush, c/o Schwazenback Huber Co., Oak St. and Bergenline Ave., West Hoboken, N. J.

VALVE-RESEATING MACHINE.—Which can be quickly secured in position on a valve casing for steam boilers and the like. Patent 1527143. R. Lakes, 205 Luqueer St., Brooklyn, N. Y.

REVERSE-MOVEMENT CONTROL FOR DRIVING AND DRIVEN ELEMENTS.—For automatically controlling the reverse movement of driving or driven elements such as power shafts and the like. Patent 1525719. C. P. Cirac, c/o Mr. Foote, 141 Grove St., San Francisco, Cal.

COAL LOADER.—In the form of a mechanical shovel which gathers a load on a forward stroke and dumps it on a rearward stroke. Patent 1526830. F. W. Byrne, No. Windsor Apartment, Connellsville, Pa.

MULTIPLE-COLOR DOT-PRINTING MACHINE.—By means of which a plurality of colors may be printed on cloth as it is passed once through the machine. Patent 1526266. L. L. De Smet, 80 Bergen Ave., Hawthorne, N. J.

CLOCK-OPERATED VENTILATOR.—For windows and other places, whereby ventilation may be secured, and an automatic closing, at a predetermined time. Patent 1525781. F. F. Sheppard, 19 Stone Ave., Ossining, N. Y.

WASHING MACHINE.—In which the washing fluid is effectively circulated through the clothes containing receptacle for thoroughly cleansing the clothes. Patent 1525784. P. E. Twiggs, Orchard St., South of Cambridge Ave., Highwood, N. J.

REGRINDING MACHINE.—For regrinding cylinder walls, adapted to have a planetary and a rotary movement while being moved downward. Patent 1527357. E. Gray, 2831 Liberty Ave., Ogden, Utah.

APPARATUS FOR MANUFACTURING ICE.—Whereby ice can be made in any desired quantity, in large clear single cakes. Patent 1527889. M. Link, R. F.D. No. 1, Box 58, New Brunswick, N. J.

VACUUM CLEANER.—With means for constantly maintaining the intake opening at a proper height from the surface to be cleaned. Patent 1527828. C. H. Barr, 1670 Elm St., Stratford, Conn.

GREASE CUP.—Which affords facilities for exerting pressure on the contents until a considerable quantity of the lubricant has been ejected. Patent 1527187. W. S. Hasleu, 521 No. 6th St., Montevideo, Minn.

HOIST DRUM.—In which an auxiliary storage compartment is provided, for cable not intended for immediate use. Patent 1527478. D. B. Harper, 55 Gale Ave., River Forest, Ill.

COMBINATION POWER SHOVEL AND DITCHER.—So arranged that the shovel can be operated in any direction, and the entire machine worked within a restricted space. Patent 1528222. B. W. Miller, 1655 Market St., Denver, Colo.

COMBINED VACUUM CLEANER AND DISINFECTOR.—Which may be readily secured to an ordinary vacuum cleaner for disinfecting the carpet of a room. Patent 1527224. E. E. Riordan, 457 N. West St., Lima, Ohio.

CARPET BEATER.—In which the blow of the beater is increased in force by a system of levers easily operated. Patent 1528708. H. P. Thiele, 268 No. 7th St., Newark, N. J.

BONE SAWING MACHINE.—With means whereby the saw may be shifted transversely in an accurate and continuous manner to split the bone lengthwise. Patent 1529303. W. J. DRUCKER, 9110 St. Charles St., Woodhaven, L. I., N. Y.

FABRIC STRETCHING AND STEAMING MEANS.—Applicable for tubular fabrics such as neckties, producing a bias fabric from a nonbias fabric. Patent 1528831. M. M. Kasanof, 1746 59th St., Brooklyn, N. Y.

SOAP DISPENSER.—For use with liquid or powdered soap, limiting the quantity dispensed, and protecting the dispenser against theft. Patent 1529388. J. D. Brant, Somerville, N. J.

### Medical Devices

IMPRESSION TRAY.—For dentists, by means of which a split impression cast may be produced without discomfort to the patient. Patent 1518308. J. E. Craig, 738 Broadway, Gary, Ind.

DOUCHE.—Adapted for universal use, but so constructed that an oil spray or powder spray may be interchangeably utilized. Patent 1528858. C. E. Sims, Gorman, Texas.

ADJUSTABLE HOSPITAL BED.—Having various controls for adjusting the bed to the needs and comfort of the patient. Patent 1529699. C. A. Hawk, c/o R. P. Clark, 110 So. Summit St., Arkansas City, Kansas.

### Musical Devices

MUSICAL INSTRUMENT—Of the viol type, in which the strains set up by the tensioning of the strings are so distributed as to maintain the parts properly associated. Patent 1514590. R. W. Parr, Edgemere, Idaho.

BRIDLE-STRAP-ATTACHING TIP.—For use in connection with piano actions, particularly in repairing bridle-straps to back stop shanks. Patent 1528700. C. N. Schneider, 150 Vermilyea Ave., New York, N. Y.

### Prime Movers and Their Accessories

TIMER.—The brush of which is formed of hard tempered steel, so supported that the spark will be accurate and reliable. Patent 1522455. H. I. and C. O. Hougen, 211 So. Grand Ave., Los Angeles, Calif.

CYLINDER HEAD FOR VALVELESS ENGINES—So constructed that a plurality of spark-plugs and like devices can be mounted thereon in a most favorable manner. Patent 1523298. C. Schaeffer, 19 Avenue d'Ivry, Seine Department, Paris, France.

AUTOMATIC DILUTION DEVICE.—Which relates to additional air regulators for carburetors of internal combustion engines. Patent 1523234. G. L. R. J. Messier, 126 Rue Fondaudège, Bordeaux, Gironde, France.

SPARK PLUG.—In which the construction of the elements forming the gaps is of a rigid nature, the plugs being undisturbed in cleaning. Patent 1523069. R. Hughes, 1316 Wesley Ave., Apt. 23, Columbus, Ohio.

SELF-GRINDING VALVE—Which will automatically rotate at a slow speed under the action of pressure from the explosive mixture. Patent 1523965. C. F. Howell, c/o Berwick Hotel, Rutland, Vt.

VALVE LIFTER.—Employed in connection with push rods whereby they may be accurately adjusted to prevent rattling when worn. Patent 1524825. H. L. Hubbard, 13823 Fernwood St., Cleveland, Ohio.

ROTARY ENGINE.—In which a plurality of cylinders and reciprocating pistons rotate about an axis and ring eccentrically mounted in respect to the axis. Patent 1526610. E. Sellberg, c/o Old Trails Garage Co., Winslow, Ariz.

SPARK PLUG.—Including separable members capable of being disassembled and readily assembled for the purpose of repair or replacement. Patent 1527106. E. N. and F. O. Alcocer, Apartado 8304, Mexico D. F., Mexico.

ATTACHMENT FOR INTERNAL-COMBUSTION ENGINES.—Providing means for intimately mixing the air and fuel together with the interception of unvaporized fuel prior to admission into the combustion chamber. Patent 1527355. S. S. Gentile, 405 Pine St., Monroe, La.

CARBURETOR.—Which is extremely economical with respect to the use of fuel, and with its parts reduced to a minimum. Patent 1527176. C. N. B. Dupiantis, c/o S. L. Quice, 429 Carondelet St., New Orleans, La.

ROTARY MOTOR.—Wherein the prime driving elements are actuated by the motive fluid pressure. Patent 1528509. R. W. Rhodes, 549 So. St., Greensburg, Pa.

ENGINE VALVE.—For controlling the motive fluid to and from multiple cylinders of internal combustion, or other engines. Patent 1528715. W. Whitten, 158 Barrett St., Schenectady, N. Y.

CUT OUT.—Having simple means whereby the same may be opened to permit of the free and unobstructed movement of the exhaust gases. Patent 1528285. O. H. Wilson, Cedar Vale, Kan.

INTERNAL COMBUSTION MOTOR.—With means for utilizing power created by the exploding of explosive mixtures without using cylinders, pistons and cranks. Patent 1529,352. A. E. Hagberg and J. E. Persson, 1380 28th St., Milwaukee, Wis.

BREATHER FOR ENGINES.—Which provides an auxiliary air supply means for the crank case of a Ford automobile. Patent 1529936. W. M. Tinniswood, 1425 Chino St., Santa Maria, Calif.

ENGINE CONSTRUCTION.—Which permits much higher revolution speeds, for internal combustion engines of the two-cycle type. Patent 1531066. J. F. Brice, 60 Wall St., New York, N. Y.

### Railways and Their Accessories

GRAIN-CAR DOOR.—Including a main built-in door, and an auxiliary door at the bottom of the same. Patent 1525280. J. E. Drake, Blue Rapids, Kansas.

AUTOMATIC TRAIN CONTROL.—Of the closed circuit type, wherein the speed diminishing mechanism acts independently of the stopping mechanism. Patent 1526750. F. T. Knight, 818 Moore St., Pittsburgh, Pa.

RAILWAY TIE AND RAIL-FASTENING DEVICE.—Whereby the rails may be readily secured upon or taken from the ties without employing any special tools. Patent 1528,146. W. E. Doane, Griggsville, Ill.

RAILROAD TIE.—Comprising three metal telescoping members and a wedge-shaped locking key for clamping the rails in spaced relationship. Patent 1529346. G. B. Cox, Wray, Colo.

TRAIN CONTROL.—For either stopping or diminishing the speed of a train according to the nature of signal set against it. Patent 1530126. F. T. Knight, 818 Moore St., Pittsburgh, Pa.

MINING EQUIPMENT.—Especially directed to a signalling system for an underground railway in mines. Patent 1529940. F. Bohy and P. L. Haser, c/o F. E. Pratt, 1st Natl. Bank, New Kensington, Pa.

### Pertaining to Recreation

GOLF CLUB.—In which a special form of weight employed in the club head, maintains a proper balance, and a more effective striking force. Patent 1525352. J. A. G. Aitken, Longwood Ave., Holyoke, Mass.

DART BOARD.—Which may be folded into compact space, and wherein a variety of target faces may be brought into play. Patent 1525339. J. F. Toohey, 2 Second St., Troy, N. Y.

BICYCLE RACE APPARATUS.—In the form of an amusement device, especially suited for pleasure parks and like places. Patent 1525278. A. Doglione, 2021 W. 7th St., Brooklyn, N. Y.

GAME APPARATUS.—Which may be used as an archery, or bowling game, and in which the elements of skill and luck provide interest. Patent 1527113. A. Bleser, 45 Clinton Ave., Lynbrook, L. I., N. Y.

PLEASURE RAILWAY.—For amusement parks and like places, providing an exhilarating ride for the passengers and considerable amusement to onlookers. Patent 1527893. W. F. Mangels, W. 8th St., Coney Island, Brooklyn, N. Y.

BASEBALL GAME.—Which is very simple, being played with specially formed dice. Patent 1527937. W. Tienken, 1452 Union St., Brooklyn, N. Y.

FIGURE TOY.—Simulating dancing dolls, to be associated with a phonograph and actuated by the turning of the record table. Patent 1527904. J. M. Nater, 806 Sip St., W. Hoboken, N. J.

GAME APPARATUS.—In the form of a captive ball, for either indoor or outdoor use, for practicing the game of golf. Patent 1528739. A. R. Boyce, 47 E. Merrick Rd., Freeport, L. I., N. Y.

GAME.—Comprising a board having the representation of a baseball field including a diamond arranged thereon. Patent 1530,035. R. H. Cotter, 859 St. Johns Place, Brooklyn, N. Y.

### Pertaining to Vehicles

AIR COMPRESSOR—Especially adapted for inflating tires of motor vehicles, or the like. Patent 1523790. A. B. Pedersen, 2110 Panama St., Salt Lake City, Utah.

BRAKE—In which the contracting band will give a more powerful and uniform grip on the drum. Patent 1523665. C. H. Stahmer, Sonora, Calif.

FOLDING VELOCIPEDE.—With means for folding into small compass for storage or transportation, yet having proper strength when set up for use. Patent 1524552. J. Hudry, 542 Klotter Ave., Cincinnati, Ohio.

BUILDING.—Wherein provision is made for the running of automobiles under their own power to and from any floor. Patent 1520,638. J. J. Gaffney and C. J. Epping, 437 2nd St., Louisville, Ky.

STEAM GENERATOR.—Designed as a small portable plant for the generation of steam power to operate motor vehicles such as automobiles or speed boats. Patent 1521,437. L. De Santis, 2308 Beaumont Ave., Bronx, N. Y.

CHOCK BLOCK.—Especially designed for chocking vehicle wheels, such as automobiles, when shipped in freight cars. Patent 1521,497. M. S. Young, 4122 Trowbridge St., El Paso, Texas.

VELOCIPEDE.—In which provision is made for adapting the chain and sprocket drive, to either a single or pair of rear wheels. Patent 1521540. J. Hudry, 542 Klotter Bldg., Cincinnati, Ohio.

CREEPER.—For tractors, in which the tendency for collecting mud, dirt or snow, is reduced to a minimum. Patent 1521454. H. H. Linn, c/o Linn Mfg. Co., Morris, N. Y.

SIGNAL.—In which the signalling element will be releasably held in either signalling or non-signalling position until manually moved. Patent 1520815. C. A. Fischer, 618 De Mers Ave., Grand Forks, N. D.

WHEEL.—Embodying a demountable rim which may be readily applied to or removed from a wheel. Patent 1521538. H. M. Howell, Box 442, Monroe, La.

ATTACHMENT FOR MOTOR VEHICLES.—Which may be attached to the forward portion of a car as a fender, and is capable of manual operation. Patent 1525400. J. J. Kilbride, 309 E. 69th St., New York, N. Y.

CARRIER.—Having means for receiving and supporting, in a safe manner, a cooking and eating equipment for use on automobiles. Patent 1524846. E. M. Stapleton, Distributor Flint Cars, Oklahoma City, Oklahoma.

EYESHIELD ATTACHMENT FOR MOTOR VEHICLES.—The inventor has been granted two patents for eyeshields, for use on any form of vehicle, which may be varied at will, or moved to an unobstructing position when not in use. Patents 1525043 and 1525044. J. W. Primrose, Planters Bank Bldg., Clarksdale, Miss.

WHEEL.—Having an integral rim and tire retaining flange, and means for holding the tire in position, especially adapted for motor vehicles. Patent 1525898. A. Teresa, Manzana de Gomez 444, Habana, Cuba.

QUICK-DETACHABLE CONNECTION FOR TIRE-VALVE STEMS.—Adapted to carry out its functions either with light or heavy types of wheels, as well as wire or disk wheels. Patent 1525573. W. R. Donaldson, 1629 Brooks Ave., San Diego, Calif.

GEAR-SHIFTING MECHANISM.—For use in connection with that form of vehicle in which the selective gear transmission is located adjacent the clutch. Patent 1526234. G. T. Randol, c/o Bank of Marmaduke, Marmaduke, Ark.

ATTACHMENT FOR AUTOMOBILES.—Whereby the power of the automobile is utilized to cause the car to move to solid ground, from mud or loose sand. Patent 1526206. A. A. Dominguez, Jr., 423 W. Canon Perdido St., Santa Barbara, Calif.

AUTOMOBILE BRAKE.—Wherein a quick braking action with maximum effect is secured by a comparatively small movement. Patent 1526121. M. Crowley, c/o Marie A. Cowing, 333 W. 87th St., New York, N. Y.

HEADLIGHT.—Which illuminates the roadway directly in front of the vehicle, illuminates the front of the vehicle itself, and eliminates glare. Patent 1524963. W. D. Baker, General Delivery, Fresno, Calif.

COMBINATION LOCK AND TIRE HOLDER.—For supporting a spare tire on an automobile, and for preventing unauthorized removal of the tire. Patent 1526611. J. S. Shands, Gainesville, Fla.

DEMOUNTABLE EMERGENCY AUTOMOBILE TIRE.—To be used in cases where it becomes necessary to remove the pneumatic tire by reason of injury. Patent 1527321. L. K. McClellan, Belfrey, Mont.

PROCESS OF AND APPARATUS FOR MANUFACTURING PNEUMATIC TIRES.—Which greatly simplifies the shaping and vulcanizing of a tire. Patent 1528659. B. de Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, N. Y.

RIM CONTRACTOR AND EXPANDER.—Easily operated to effect the certain and ready contraction and expansion of a split rim. Patent 1528295. J. L. Greenwood, North East Harbor, Nova Scotia, Canada.

AUTOMOBILE CHOCK BRAKE.—Designed to be used in emergency, acting as a continuation of the usual control mechanism. Patent 1528025. O. S. Payzant, R. 2615, Grand Central Station, 42d St., New York, N. Y.

AUTOMOBILE CUSHION.—Consisting of a series of approximately air-tight units, with means whereby air is expelled under compression and admitting it when force is released. Patent 1528153. B. Kerr, 371 Cromwell St., Sarnia, Ontario, Canada.

LOW LEVEL ALARM SWITCH.—Adapted to indicate when the fuel in a gasoline tank of an automobile drops below a predetermined point. Patent 1529470. J. E. Dowd, 1600 Michigan Ave., Salt Lake City, Utah.

JACK.—Which with slight modifications may be used to advantage as a brake for vehicles, in addition to its regular use. Patent 1528977. J. O. Leonard, 391 So. 5th St., Middleport, Ohio.

VEHICLE BRAKE.—In the form of an external brake which may be operated from a remote point. Patent 1529377. D. H. Schall, Wernett Bldg., Room 21, Canton, Ohio.

HEADLIGHT OPERATING MEANS FOR AUTOMOBILES.—Arranged to operate by the movement of the steering means for turning the lights to the right or left. Patent 1529357. S. L. Harwood, Uniontown, Alabama.

PNEUMATIC CUSHION FOR VEHICLES.—Supported between the body and the running gear for neutralizing the recoil due to road shocks. Patent 1530043. M. R. George, 3720 Main St., Apt. F, Kansas City, Mo.

VEHICLE DRIVE—Whereby the front wheels or the rear wheels of a vehicle may be selectively, or simultaneously driven. Patent 1529932. G. W. Smith, 4529 E. Grand Ave., Dallas, Texas.

TEMPERATURE INDICATOR.—For the cooling system of a motor vehicle, indicating the temperature of water in the circulation system. Patent 1530382. S. Ligotz, 203 W. 62d St., New York, N. Y.

VENTILATING COVER FOR VEHICLES.—Attachable either to the roof of a closed car, or an engine hood, and providing space above for air passage. Patent 1530540. C. F. Bouffier, 903 Bannock St., Boise, Idaho.

AUTO HORN.—Which is mechanically operated with ease, gives the desired sound, and is not liable to get out of order. Patent 1531120. A. V. Marsik, 73 19th St., Jackson Heights, L. I., N. Y.

### Designs

DESIGN FOR A BATHING SUIT.—Patent 66,586. Mildred C. Schmolze, c/o Franklin Simon Co., 38th St., and 5th Ave., New York.

DESIGN FOR FRINGE.—Patent 66,590. A. Sussman, c/o J. Kremer, R. 2236, Woolworth Bldg., Broadway, New York.

DESIGN FOR A COAT.—Patent 66711. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 66,710. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 66709. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A BLOUSE.—Patent 66708. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A LAMP.—Patent 66717. P. Siptrott, c/o Harry Sussman, 402 Ditmas Ave., Brooklyn, N. Y.

DESIGN FOR A BASKET—Patent 66397. D. Bloom, 1538 Edith St., Berkeley, Calif.

DESIGN FOR A LAMP SHADE.—Patent 66,762. J. Bennici, 713 Gladys Ave., Los Angeles, Calif.

DESIGN FOR A BATHING SUIT.—Patent 66,890. Mildred C. Schmolze, c/o Franklin Simon Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR WALL PAPER.—Patent 66,823. F. J. Beger, c/o Standard Wall Paper Co., Hudson Falls, N. Y.

DESIGN FOR PRINTED FABRIC.—Patent 66,883. R. Schey, c/o Klein Messer Co., Inc., 139 5th Ave., New York, N. Y.

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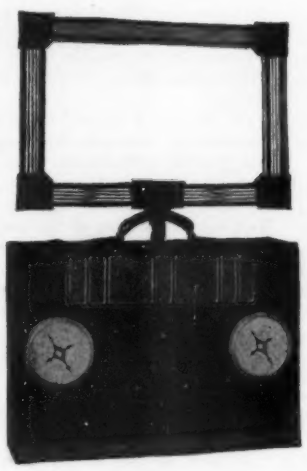

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# The Scientific American Digest

*A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering*

*Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue*

**Conducted by Albert G. Ingalls**

## *A Fly Versus a Civilization*

If the organized efforts that are now being made to get rid of a small African insect called the tsetse fly prove successful, we may look forward to the comparatively rapid settlement of another continent. Just as the Panama Canal could not be dug until two Englishmen and two Americans found out that yellow fever could be wiped out only by eliminating the mosquito, so the little tsetse fly, not very different in appearance from our own housefly, and often the bearer of the dread sleeping sickness is actually holding up the development of the major part of Africa.

Africa has been called the Dark Continent, and many people still believe that it is a vast tract of impenetrable, fever-laden jungle, dominated by savages and great beasts. Yet such is the case only in a fraction of this immense continent, chiefly in the basin of the Congo River. A large part of the remainder of Africa could be inhabited by the white man were it not for the tsetse fly. This harmless looking insect kills horses, cattle and the native alike, though it is comparatively easy to prevent it from biting the white man. Without horses, and particularly without cattle, a civilization cannot be built.

Suppose that you were given the problem of exterminating an insect that lived out of doors—how would you go at it? Probably you would study the whole life history of an individual insect, in hopes of finding some part of its round of existence during which it is especially vulnerable. In the case of the tsetse fly you would meet with an agreeable surprise. Instead of laying thousands of eggs this remarkable insect hatches only one egg at a time. Therefore it breeds very slowly.

As soon as a larva has been hatched it burrows into the soil, choosing only loose, dry ground, well shaded. Accordingly, the plan of C. F. M. Swynnerton, who is now in charge of tsetse fly work in Tanganyika Territory, is to burn off the grass and brush late in the fall, thus scorching the larva while they are changing to pupae in their shallow resting places in the soil.

A second method of attacking the tsetse fly is by means of the decoy trap. Dummy animals and images of donkeys with brown paper legs are quite successful when scented with the proper animal odors. The fly is not active and may be killed easily by black boys whose hire is very cheap.

A third method of attack abandons the




Courtesy of "Natural History"

**The water-loving species of tsetse fly is more limited in its range (ruled area) than the more active species (dotted area) which ranges over an immense and potentially habitable part of the vast African continent**

The tsetse fly first bites some wild animal that is infected with the germ of the sleeping sickness. Next it bites horses, cows or man, thus transferring the sleeping sickness germ. How, then, can the disease be got rid of? One way is to get rid of the fly itself. Another is to get rid of the animals from which the fly first gets the germ of sleeping sickness.

At present there are six government stations in South Africa and East Africa organized for the study of this important problem, and most of the research has been done since the World War, so that we may regard the tsetse fly problem, not as a hopeless one, but rather as one about which until quite recently there has been more talk than actual work.

hope of exterminating the tsetse fly itself, but depends upon exterminating the germ which the fly often carries in its blood. This, it is thought, would be accomplished by killing all the big game, for the tsetse fly gets its germs entirely from these animals, and particularly from the antelope. Not all flies are thus infected, however, and the bite of a non-infected tsetse fly is perfectly harmless.

Many people fear, however, that in a large part of Africa, it would be all but impossible to exterminate every bit of the disease-bearing wild game and that a few animals left with the germs in their blood ready to be rebitten by new tsetse flies would start the spread of sleeping sickness over again.

(*Continued on page 404*)

# WAGES

A COOLIE works ten or twelve hours a day. If he carries all he can, he moves *one* ton *one* mile in *one* day. For that, he receives twenty cents. "Cheap labor," you say.

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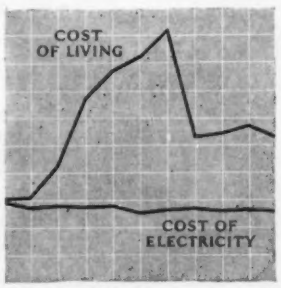
America has in its service as much electrical energy as the rest of the world combined. And, through the efficiency of the electric light and power companies, the cost of this electrical energy has been kept amazingly low. (See the little chart.)




Plenty of electricity and cheap electricity—these are two great advantages which America enjoys over the rest of the world. They help to explain why we can have our high wages, our quantity production, and our low costs.

Every year sees a great advance in the use of electricity by railroad men and by the managers of industries, for these men know that electricity cuts costs. Are you taking full advantage of its economies in your home, your office, and your shop? Each new discovery of uses for motors and other products made by the General Electric Company means more comfort and more economy for somebody.

# GENERAL ELECTRIC

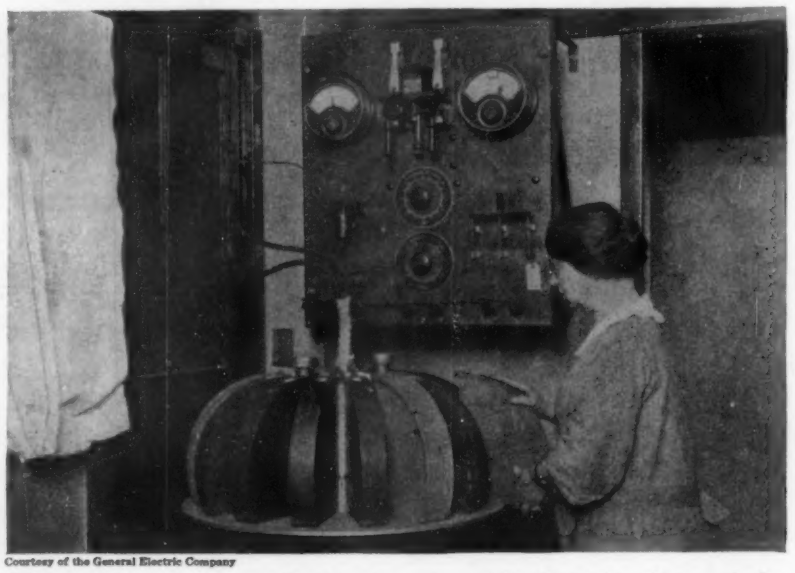
95-32A

Others hold, that there used to be sleeping sickness in the Transvaal, but that with the extermination of the wild game it wholly disappeared from that southern locality.

Two or three efforts have recently been made to cope with the disease with specific remedies. In May, 1922, the German, Professor Martin Meyer, claimed complete prevention as well as cure of sleeping sickness by a secret drug called Bayer 205, discovered in Germany. It was intimated that this secret might be revealed to the British for the return of the former German colonies. However, the French soon brought out a similar remedy; while Dr. Louise Pearce has been using a preparation called tryparsamide in the Belgian Congo.

Sleeping sickness is not a scientific term and has been loosely used. In this country there are no tsetse flies and the African disease does not exist at all. What we sometimes call sleeping sickness is not in any degree related to the African disease but is generally cerebral meningitis or some other disease of the brain which causes deep lethargy and continued sleep. These diseases are due to various bacillae; while the African sleeping sickness is caused by germs that under the microscope look like irregular corkscrews and are called trypanosomes.

Some day the scientists working under the British colonial governments in Africa, or other agencies working on the same problem, will probably discover an effective way to cope with the tsetse fly and sleeping sickness. From that day on, Africa will rapidly take its place as a center of colonization, for nearly everything that man needs with which to build a civilization exists there in abundance.—*Nature* (London), vol. 115, pages 160-161 (Jan. 31, 1925) and pages 338-339 (March 7, 1925); *Natural History* (New York) issue of Jan.-Feb., 1922; and *The South and East African Yearbook and Guide*, 1925, pages 633-634.



Courtesy of the General Electric Company

**The apparatus which proved that science was right about the theory of the spacing of atoms**

## *"Seeing" the Atoms With X Rays*

LIGHT may be spread out into its spectrum by means of the diffraction grating, which consists of a polished surface having about 20,000 parallel lines ruled across it for each lineal inch. Knowing this fact, how would one go about the problem of similarly spreading out the X rays? These rays differ from light rays only in their length, being about ten thousand times shorter?

In order to make a suitable diffraction grating for X rays, a polished surface would therefore have to be ruled with 10,000 x 20,000 parallel lines per lineal inch, or 200,000,000 lines. This cannot be done. We cannot make such a minutely ruled grating.

However, in 1912, M. von Laue, an Austrian scientist, discovered another and equally good method of doing the same thing. It occurred to him that if the atoms of matter, which no one has ever seen because no microscope in existence even approaches power enough to make them visible, were actually spaced as closely together as theoretical considerations indicated they should be, then they would themselves make an excellent diffraction grating for the extremely short X rays.

Von Laue at once put his theory to the test and was rewarded by a clear demonstration that it was valid. The atoms of crystals, just as they were found in nature, constituted a grating of just the right spacing.

What is the utility of these discoveries? It enabled scientists to find out exactly how the atoms of various substances are grouped, and it showed us that the theoretical or mathematical deductions concerning these groupings and arrangements made by crystallographers before any empirical method of determination was found, were correct.

The atoms of crystals turned out to be as neatly and geometrically arranged in the crystals as rows and tiers of uniformly shaped boxes are arranged in a storeroom.

Not only did the natural diffraction gratings for X rays thus enable us to "see" the interior of crystals, but the work was turned around the other way—with crystals having known atomic spacings we were able to learn many facts that we did not previously know about the nature of X rays.

Of course, we do not actually *see* the atoms, even with the method originated by von Laue and perfected by Sir William Bragg. What we do, is to shoot the X rays into the crystals and then observe certain *effects* which they produce.

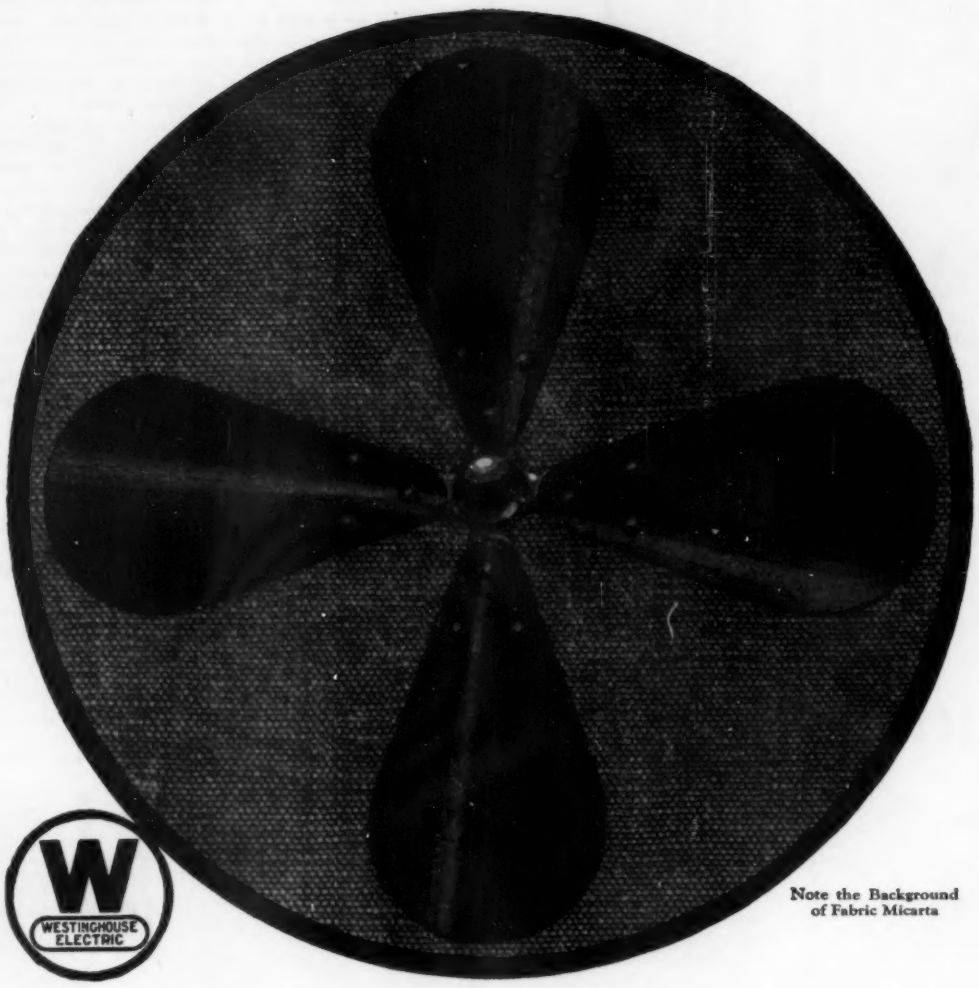
In science, a great deal may be determined by the study of effects. It is as if a blind man were attempting to make an observation normally requiring sight. Suppose he wished to determine the angle at which a rubber ball thrown at a wall would bounce off. He could not see the ball, but by placing opposite the wall some object like a screen of soft, fresh plaster which would bear a permanent imprint of the rebounding ball, he could find out how the ball behaved.

This is very nearly what is done in the X ray analysis of crystals. The X rays are shot into a crystal and then we observe the effects of the refracted rays on photographic plates placed nearby. It turns out that the X rays strike on the facets of many of the atoms and rebound or glance back at the photographic plate in certain definite paths. Thus they leave clear imprints on the photographic plates.

The whole subject of the X ray analysis of crystals is a most interesting and remarkable one, though it is not very simple to grasp unless one has studied previously about various kinds of minerals and crystals. In *The Structure of Crystals*, by Ralph W. G. Wyckoff (The Chemical Catalog Company, New York) this new branch of science is very thoroughly described. The

(*Continued on page 406*)

# Now It's Used for Fan Blades!



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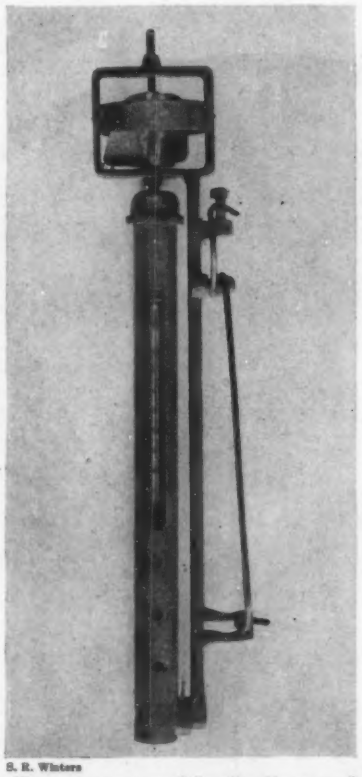
same subject is treated in a somewhat more brief manner by A. E. H. Tutton in *The Natural History of Crystals* (E. P. Dutton and Company, New York), a book which, like the first, is chiefly devoted to the study of many aspects of the science of crystallography.



S. R. Winters

**Thermometer used by the Coast and Geodetic Survey in taking temperature of sea water at extreme depths**

### *Temperature of Ocean at Depth of Five Miles*

DID you know that the thermometer has been let down into the sea to a depth greater than the elevation of Mount Whitney—the highest mountain in the United States? It is difficult to conceive the taking of temperature of water five miles below the surface, and yet this is an accomplished fact.

Obviously, the types of thermometers in common use are not adapted to the service of recording the degrees of heat and cold at various depths of the sea, so the Coast and Geodetic Survey has designed a special thermometer which is contained in a shell-like enclosure, attached to a tripping frame.

The apparatus, weighing about two pounds, has a clamping wire on the carrying frame which holds in place the fine piano wire, used as a reel. This is carried to extreme depths of water by means of a detachable piece of cast iron, weighing about seventy pounds. The latter is sent to the bottom of the ocean as a sounding device, while the thermometer goes within six feet of the bottom. As long as the thermometer is being let down in the water, the device is inoperative insofar as concerns its recording mechanism—it simply registers temperatures, with none to see. A small propeller is mounted at the top of the carrying case and the water causes this to revolve.

Once the guiding weight strikes the bottom of the ocean, the propeller stops revolving, releasing the tube carrying the thermometer; and when a start is made to recover the wire reel, the carrying case capsizes or is tripped. This breaks the column of mercury at the temperature of the water, which is thus recorded automatically.

• • •

### *Tidying Up the Untidy Cottonwood Tree*

BY spraying the cottonwood tree with a two percent solution of sulphuric acid during the three weeks between the time when the catkins appear and when the leaves are unfolding, Dr. W. H. Long of the United States Bureau of Plant Industry at Albuquerque, New Mexico, has discovered that the blooms which shed cotton over lawns and all surroundings during a certain period of the year may be killed successfully, rendering this otherwise valuable tree a desirable neighbor.

The discovery of this simple method of keeping the cottonwood tree neat was made in the following manner. Dr. Long noticed that a large number of beautiful cottonwood trees were purposely being destroyed because they were considered to be a public nuisance. Others were being pruned back severely, so that they could not bear the objectionable tufts of cotton for several years. Dr. Long at once began considering whether some spray might not accomplish the desired result without otherwise injuring the beauty or the shade-producing qualities of the trees.

The cottonwood, Dr. Long explains, is one of a group of trees which bloom before the leaves open in the spring instead of afterwards, as most trees do. There are two kinds of cottonwood trees, the male and the female. The flower which produces the untidy cotton is borne by the female tree. The cotton is simply nature's way of distributing the seeds of the tree which it contains, and which the breeze carries aloft and afar. The male tree does not produce cotton. Its function is to make pollen with which the cotton blooms are fertilized. The female blooms are green; while the male blooms are purplish. This makes it easy to distinguish the female trees, and thus give them the required spraying.

In seeking to discover some suitable spray, indoor tests on branches of the cottonwood tree were made at first. Different branches were sprayed with various solutions. A sulphuric acid solution proved the most efficient. It kills the blooms within twenty-four hours.

The spray is put on with the same type of power-driven sprayer that is used for spraying elm trees; that is, a triplex force pump having three cylinders and giving a pressure of about 300 pounds per square inch. Since sulphuric acid destroys the ordinary cylinders of these pumps, cylinders of copper-alloy were used. Each tree requires about ten minutes of spraying, and from eight to fifteen gallons of solution.

Reproduced from "American Forests and Forest Life"

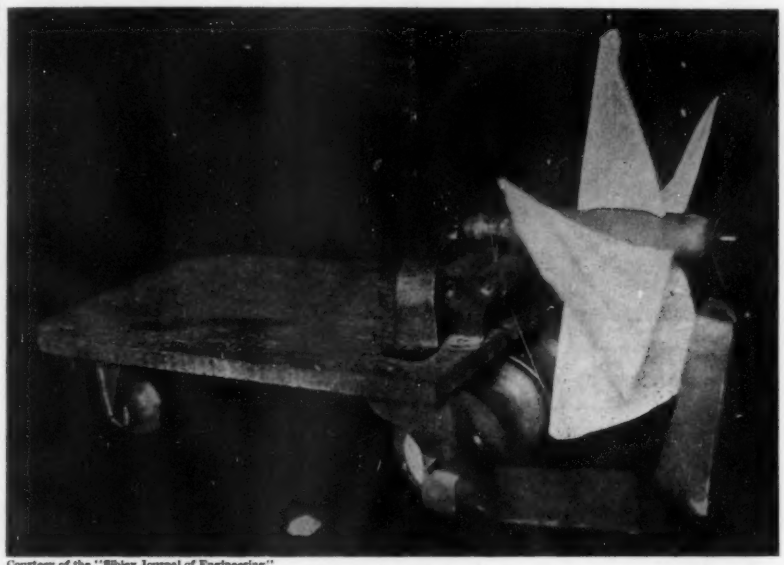
**When the cotton-bearing catkins are sprayed with acid solution at this stage of their development they are killed, and therefore the trees shed no cotton**

The total cost of the work ranges from twenty-one to thirty-two cents per tree. Dr. Long states that the same kind of spray is

also valuable for use in destroying the blossoms of other trees which bloom before the leaves put out.

The acid solution is made in small amounts by adding two and one-half fluid ounces of sulphuric acid to one gallon of water. In large amounts, add one gallon of sulphuric acid to forty-nine gallons of water. Add the acid *to* the water, stirring it in. If you add the water *to* the acid it may spatter and cause severe burns.

The acid used is the strongest commercial grade, which approaches a strength of ninety-five percent. If the acid obtainable is not so strong, use more acid in proportion. This acid, before dilution, eats through clothing and injures the skin. While the acid in concentrated form is strong enough to do considerable damage, when diluted for application it does not injure the lawn under the tree, the paint on adjacent buildings, nor, according to Dr. Long, the workmen using the sprays.—*American Forests and Forest Life* (Washington, D. C.), vol. 31, pages 144-146 (March, 1925).



Courtesy of the "Sibley Journal of Engineering"

**A wind-driven machine, which flies in the face of the wind; and of logic as well**

### *Mechanical Paradox—or Mechanical Fact?*

THAT a vehicle may be made to move directly against the wind by means of a windwheel actuated by the same wind is the claim put forward by Professor Irving P. Church, Emeritus Professor of Applied Mechanics and Hydraulics at Cornell University (Ithaca, N. Y.).

When confronted by this statement a number of scientists and engineers have stated very positively that such a vehicle is a mechanical paradox and that it would not work. However, Professor Church states that he has actually constructed such a device and that it does work.

Professor Church's wind-locomotive is not a sailboat in any sense of the word. A sailboat never moves directly into the eye of the wind, but is forced to tack. The wind-locomotive does not tack; it moves square into the breeze.

"Professor Church's device would have to operate on the same principle as a man lifting himself by his bootstraps," says one commentator. But, says Professor Church, the original model of the wind-locomotive is now in the museum in the College of Civil Engineering of Cornell University, where it may be seen; and if necessary it may be taken out and caused to move directly against the wind.

"Given an ordinary safety bicycle," writes the professor in proposing an analogy to the wind-locomotive, "standing at rest on a level floor, but with no rider, supported laterally to prevent tipping sidewise and with one of its pedals in its lowest position: will the bicycle begin to move forward, or backward, when an extraneous backward pull is exerted horizontally on this pedal by means of a cord attached to it?"

In the model of the wind-locomotive illustrated on this page the spindle to which the diagonal fans of the windwheel are attached, and the deeply grooved spools which serve as wheels for the device, are connected by a continuous cord belt. It is assumed that the spools or driving wheels of the locomotive maintain perfect rolling contact with the rail or floor, without slipping; and also that the belt does not slip on either pulley. This is quite essential, says Professor Church, who is the author of an authoritative textbook on the subject of *Mechanics*, a fundamental subject which underlies all engineering practice, and one with which many a bewildered college man has struggled.

The model illustrated on this page is about fifteen inches long, most of this length being occupied by a platform for "freight." There is a single undriven wheel at the rear. The model makes steady progress against the wind, regardless of one's instinctive feeling that it could not possibly do so. Professor Church demonstrates mathematically why this is possible, the demonstration being too long to reproduce in these columns.

The wind-locomotive, or modified apparatus designed to work on the same principle either on land or water, has frequently been proposed, and many inventors have endeavored to perfect practical devices, chiefly, however, in the form of sea-going ships, which are driven straight against the wind by the wind's own force. None of them has as yet proved a practical success in an economic sense. Professor Church has not attempted to demonstrate that his wind-locomotive is destined to replace other forms of prime movers.—*The Sibley Journal of Engineering* (Ithaca, N. Y.), vol. 38, pages 214-217 (December, 1924).

* * *

### *Treating Concrete Roads with Vibrations*

BY deliberately unbalancing the flywheel of a small gasoline engine, so that the entire engine vibrates very vigorously, and mounting this engine on small wheels so that it may be moved about on top of newly laid concrete roads by workmen, a process of giving such roads an extremely hard and quick-setting surface has been developed. The concrete road after being treated with this peculiar apparatus is so dense that nothing short of a pick or a crowbar will disturb it. Even a motor truck can run across it while it is still green (not yet set) without making more than a shallow impression.

The gasoline engine used is quite small and light. Anyone knows that if a flywheel is out of balance, that is, if one side of the wheel is heavier than the other, it will vibrate excessively when in rapid motion.

Whereas most engine designers are anxious as far as possible to eliminate unbalanced forces which cause engine vibration, one side of the flywheel of the engine used in the vibrolithic process of roadmaking is purposely equipped with four iron lugs weighing one ounce each. The effect of these four unbalanced ounces is to cause powerful vibrations when the flywheel is in rapid motion. These vibrations are transmitted through the engine and wheels to the newly poured surface of the concrete road, and they beat it down and compact it to such a high degree that the workmen can at once walk over the road without leaving any impression.

The machine is not, however, run immediately on the surface of the road, but on wooden mats, each sixteen feet wide and twelve feet long. These mats have transverse wooden cleats nailed to their under sides, the cleats being almost one-inch square and being spaced five-eighths of an inch apart. These cleats leave the road deeply corrugated after the vibrating is done.

Courtesy of the American Vibrolithic Corporation

**The compacting machine which treats roads with vibratory massage**

It is evident that the vibrolithic process is a way of treating any road, not a particular type of road. All kinds of concrete roads can be finished by vibration. Its advantages are, so it is claimed, economy of surface consolidation, exceptionally strong and dense concrete, and quicker use of the road after construction. It gives immediately, by hammering broken stone into the surface of a green or unset road, a firm load-bearing surface. The total labor cost is the same as that for a standard job of the same thickness and amount of reinforcement.

After the concrete has been poured and spread and a layer of crushed stone from one to 2½ inches in dimensions has been spread over the whole top by hand, the cleated platforms or mats are placed on the surface and the vibrators are pushed back and forth over them like a vacuum-cleaner. This takes but a few minutes. All voids in the concrete are completely filled and the excess water squeezed out. The excess mortar thus brought to the surface is then smoothed or floated and the section under vibrolithic treatment is complete.

Rain causes no injury to a freshly vibrated surface, according to the statement of the American Vibrolithic Corporation (Des Moines, Iowa), owners of the patents on the apparatus with which the process is conducted. The early development of the strength of the road due to the compacting caused by the vibrolithic process permits it to be opened to traffic in about ten days instead of the usually longer period.—*Engineering News-Record* (New York), vol. 94, pages 26-29 (Jan. 1, 1925).

### *Why Cats Can See at Night*

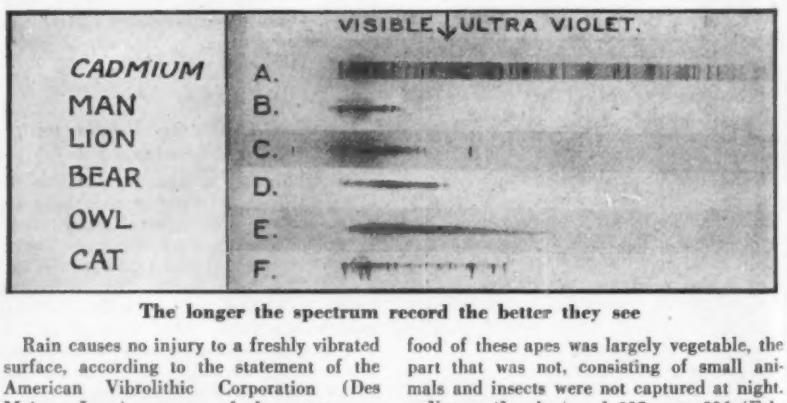
RECENT experiments throw new light on the apparent superiority of vision in animals that are active at night. Evidently they see not only the part of the light spectrum that we see, but some of the ultra-violet light as well. This greatly improves their vision.

In order to ascertain just what part of the spectrum various animals do actually see, their eyes were dissected out and placed before a quartz spectrometer, an instrument for measuring the spectrum of light radiation. A small portion at the back of the various eyes was cut away and a thin quartz plate was cemented over the opening in each. Quartz was used instead of glass because glass would shut out the ultra-violet rays which might pass through the eye, while quartz does not.

First a record of the spectrum of light was made by means of a tungsten arc light. This record (see illustration, upper band) includes the rays that are visible to man as light, as well as the shorter ultra-violet rays that humans cannot see. This record served as a basis of comparison between the various animal eyes, those of man, and the actual spectrum of light.

The second band shows the record that was made when the human eye was the subject of experiment, and it is the shortest of all, indicating that man's eyes do not make use of the ultra-violet rays of light. The lion is slightly better able to see at night than man is, according to the evidence of the third line; while the bear is still better equipped for night seeing than the lion. The owl, a nocturnal animal, is the best equipped of all; while the tiger and the common cat, both strongly nocturnal, are nearly as capable of seeing at night as the owl.

The owl does not depend on the sense of smell at all, while the cats of various kinds are aided by this valuable sense which is developed to a high degree. The human being depends upon his brain power for capturing his prey; but his ape ancestors, it is believed, depended largely on the sense of sight rather than that of smell. They were not, however, nocturnal in their habits. The food of these apes was largely vegetable, the part that was not, consisting of small animals and insects were not captured at night. —*Nature* (London), vol. 115, page 306 (Feb. 28, 1925).




**The longer the spectrum record the better they see**

* * *

### *Some Drinking Founts Are Unsanitary*

THE bubbling drinking fount that looks so innocent may be almost as dangerous as the old-fashioned public drinking cup.

Drinking founts having a vertical stream of water that falls back on the nozzle from which it issues are to be avoided. These straight-jet fountains may result in the transmission of bacteria from one person to another, according to the final report of the Committee on Sanitary Drinking Fountains of the American Water Works Association.

In the early period of the manufacture of such equipment, that is, the years following its first general introduction in 1910, no special thought was given to the sanitary efficacy of the equipment, with the result that many types of fountains were put in service, the use of which was as potentially dangerous as was the common drinking cup.

If the incoming water passes through a small reservoir or cup that is not drained, or if the drinking fount is so designed that the drinker can reach it with his lips, it is a sanitary drinking fountain only in name.

Courtesy of the Crane Company

**The modern type of drinking fount has a sloping jet**

The Railway Sanitary Code of the United States Public Health Service specifies the kind of fountain that is sanitary and permissible. They must be "so made that the drinking is from a free jet projected at an angle to the vertical and not from a jet that is projected vertically or that flows through a filled cup or bowl."

Despite this clean-cut distinction between the sanitary type of drinking fount and the unsanitary type, a great variety of both kinds is still on the market. The next time you drink from a fount, notice whether the jet falls back on the nozzle or not. If it does, you might as well use the proverbial moss-grown public cup.

* * *

### *How Fossil Plants Tell the Secrets of the Earth's Early Climate*

AT the recent meeting of the American Association for the Advancement of Science, Dr. David White, chairman of the division of geology and geography of the National Research Council, presented the results of his studies of the records of ancient climates as they left their mark on the plants of those remote geological periods.

In the most ancient of the rocks that yield any recognizable organic remains, the Cambrian, Ordovician and early Silurian periods of geology, there were few or no land plants. Fossil remains of primitive blue-green seaweeds, however, indicated that there was an abundance of sunny weather over the warm, shallow seas of those extremely remote days. Later, in the Silurian period, types of amphibious plants evolved from the seaweeds. They required immersion part of the time, but were stiffened sufficiently to endure exposure to the world above the waters for considerable periods.

In the next period, the Devonian, the development of land plants had proceeded to a point where they formed extensive swamps. Huge plants resembling seaweed with trunks three feet in diameter stood up in the sunlight. The climate of this period must have

been rather even, for the plants did not develop annual rings as trees do now, and there was plenty of dry, sunny weather.

Next came the earlier coal age, the Mississippian. This was, for the most part, warm and rainy apparently all over the earth, for fossils of subtropical plants of this age are found today in the Arctic. The coal age proper, or Pennsylvanian Period, followed, still with an equable and apparently warm climate. The subtropical nature of this climate is indicated by the richness of the plant remains, the great thickness of the coal beds, and by the lace-like delicacy of the leaves of many of the plants. There were extensive swamps, for fossil tree stumps show thickened bases and knees such as are found in swamps today. That there was considerable wind is proved by the fact that winged seeds were common. In the latter part of this period, the fossils show that harder times had come, for the delicate-leaved plants disappeared, and tougher plants inured to desert conditions began to come in.

The Paleozoic era of geology closed with the Permian Period, which reached to the dawn of the Mesozoic, or the Middle Ages of geology. This Permian Period began with a glacial epoch, much like the one the earth experienced recently. but more severe and longer. Queer fern-like plants, adapted to severe climates, mark this frosty time. Then came another long season of equable weather alternating with times of cold or drought. We know this because annual rings of growth again appeared in the perennial plants. But the great climatic feature of this age came at its close, when the whole world apparently was scourged with drought. Plants adopted to desert conditions of life dominated the earth, and the first ancestors of certain modern conifer families like the pines appeared.

According to Dr. White, we are now living in one of the periods of abnormal weather. Relative equability and mildness of climate are, geologically speaking, normal. Great climatic range and variability, both seasonal and geographic, are, on the other hand, abnormal, and are confined for the most part to periods of mountain formation, such as that in which we live.

* * *

## *A Moon Which Turned Out to Be a Planet*

LATE last autumn some of the newspapers contained the announcement that a second moon had been discovered, revolving around the earth. This extra satellite was invisible to the naked eye, it was said, because it was only about four hundred feet in diameter; while its very high apparent velocity rendered it difficult to observe with astronomical telescopes. Being only 2,500 miles away from the earth it made one complete revolution every two and one-half hours.

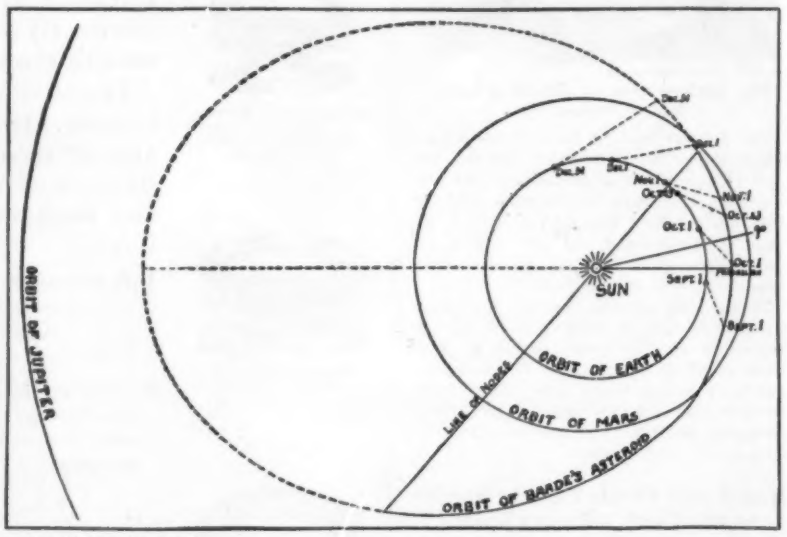
This announcement was received with incredulity by many. Yet there is no scientific reason why the earth should not be accompanied by more than one moon, for some of the planets have several. Should some wandering object of small size happen to pass close enough to the earth it might be captured by the earth's gravitational attraction and begin whirling around our planet as a moon.

Astronomers have now observed this new body, which was first seen by Dr. Baade, astronomer of the Hamburg Observatory, Germany, on October 23d, and have announced that it is not a second moon revolving around the earth, but a planetoid or asteroid revolving about the sun just as the earth does, except in a very much less circular orbit. It had been given the provisional designation of 1924 TD. A planetoid or asteroid is simply a very small planet.

There are at least one thousand minor planets or planetoids revolving around the sun in orbits situated between those of Mars and Jupiter, and we are constantly adding to the list.

The asteroids were first discovered as the result of a mathematical deduction, rather than by direct observation. The planets, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune revolve around the sun in orbits which are not spaced willy-nilly, but for some as yet unknown reason, they obey in their spacing or distance from the sun a law of nature, called Bode's law. If one writes down a series of numbers, each of which is double the last, beginning with 3, the result is like this: 0, 3, 6, 12, 24, 48, 96. Now if we add 4 to each number in this series we get a new series, thus: 4, 7, 10, 16, 28, 52, 100.

The second series of numbers represents very closely—too closely to be purely accidental—the relationship in which the planets




Courtesy of "Popular Astronomy"

**Last winter the newly discovered Baade's asteroid came very close to the earth**

actually lie in distance from the sun, but we do not know why this interesting relationship exists. There is, however, no planet for the number 28 in the numerical series just given.

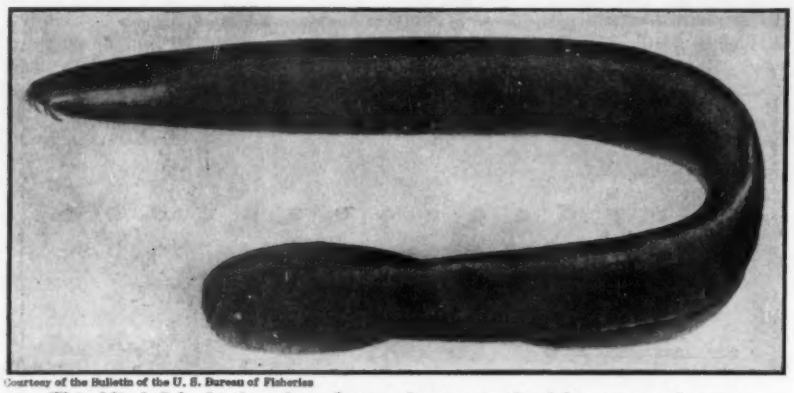
This omission, when noted, was extremely suggestive and astronomers concluded that an undiscovered planet must lie in the space between Mars and Jupiter, since Mars corresponds to the number 16 in the series, and Jupiter to the number 52. The astronomers began a systematic search for this missing planet, but they did not find it. Instead, they did find the planetoids, or asteroids, hundreds of them, of which the discovery of Dr. Baade is simply the latest.

In 1801 the Italian astronomer, Piazzi, found the first planetoid, which was named Ceres. Within seven years, Pallas, Juno and Vesta were added. Later in that century, planetoid after planetoid was added to the list, and asteroid hunting became a regular astronomical sport.

Today, asteroids are hunted by means of the camera. One method is to photograph a

part of the heavens through a telescope, with a thirty-minute exposure. The telescope, driven by clockwork, follows the stars, but the planetoid moves during the exposure of the photographic plate, leaving a short line on the developed negative instead of a dot. Thus the planetoid almost finds itself.

While the game of planetoid hunting was young there was good hunting, so to speak. Today, most of the larger planetoids have been found and the search is now directed towards the discovery of the smaller ones. Ceres, the largest of all, has a diameter of only 485 miles. The majority are much smaller than this, not more than fifty miles in diameter, and in many cases only ten or twenty miles in diameter. It is very probable that the combined mass of all the asteroids so far discovered, plus those which have not yet been discovered, does not equal the mass of the planet Mars. None of them has an atmosphere.



Courtesy of the Bulletin of the U. S. Bureau of Fisheries

**This blind fish, having three hearts, locates its food by some unknown chemical sense**

How the asteroids originated is not known. One conjecture is that they are the remaining fragments from the break-up of a planet of size comparable to the eight regular planets that revolve around the sun. This is only a conjecture and it must be confessed that the problem of the origin of the asteroids has not yet been solved.—*Discovery* (London), vol. 5, pages 342-343 (Dec., 1924); also see brief notes and ephemeris of Baade's asteroid in *Popular Astronomy* (Northfield, Minn.) issues of Nov., Dec., 1924, Jan., Feb., Mar., 1925.

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### *A Blind Fish That Puzzles Science*

A PRIMITIVE, blind fish, having three hearts and a sense of smell controlled by some unknown kind of chemical guidance is the object of a series of baffling investigations now being made by scientists. This fish, known as the hagfish, abounds in Monterey Bay, California, and is so voracious that net fishing in those waters has been rendered practically impossible.

"Hagfishes alone among fishes are truly parasitic," says Dr. David Starr Jordan, in *Fishes*. "They fasten themselves at the throats of large fishes, work their way into the muscle without tearing the skin, and finally inside, devour all the muscles of the fish, leaving the skin unbroken and the viscera untouched. These fishes become living hulks before they die."

Physiologically, the hagfish is extremely interesting. Although it is blind, it has rudimentary eye spots. These are not, however, sensitive to light. The skin of the adult is continuous over these eye spots, though the areas are characterized by the absence of skin pigment. The rudimentary and sightless eyes themselves are embedded in pits in the cartilage of the skeleton of the head.

Although the hagfish is blind it is sensitive in two ways. When touched, however lightly, the head of the fish is instantly drawn back to a distance of almost one-half the length of the body and the fish swims away. The hagfish has another sense which has its analogy in man and the other mammals that smell. If a bit of food is dropped into an aquarium with a hagfish there is instant commotion. The blind fish swims toward the general direction of the food, apparently guided by some chemical sense. Contact with odorous substances is facilitated by respiration.

The branchial pouches act as a pump to draw water in at the nostril and drive it out at the gill openings, and a sort of check-valve prevents the circulation from being reversed. It is thought by Dr. Charles W. Greene, of the Department of Physiology of the University of Missouri (Columbia, Mo.), that this mechanism carries odorous particles to the olfactory or smelling organs of the fish.

That this peculiar sense, which may not be the same as the sense of smell as we know it, is far-reaching, is shown by the method used by Prof. Greene for trapping the hagfish in Monterey Bay for experimental purposes. A five-gallon oil-can was punctured by a number of small holes just large enough to admit the fish, but with the roughened edges turned in to retard the exit of the fish. The trap was liberally baited with dead fish and lowered to the bottom of the bay.

In the most successful catch made the trap was completely filled with hagfish, sixty-seven specimens being secured. Full-grown specimens are about eighteen inches to two feet long. The color is a purplish blue.

The hagfish has three hearts. The eels of the waters of the Atlantic seaboard and Mississippi Valley have two, one being the regular organ, the other a contractile organ in the tail. The hagfish has, in addition to the regular heart, a special heart for the portal system of veins. This heart has its own incoming and outgoing blood vessels and all are well equipped with valves to insure that the blood takes a one-way course.

The third heart is in the tail as in the eel. This, too, is a true pump, supplied with valves. It is double, but unlike the other two hearts its walls are not themselves able to contract. The power is therefore otherwise supplied by a pair of striated muscles controlled by nerves. The other two hearts are not controlled by nerves.

There are still many facts of the biology and natural history of this peculiar and primitive fish to be determined. Living specimens are now kept in the Steinhart Aquarium of the Golden Gate Park in San Francisco. Scientists have come to California from distant parts of the world, purposely to study the hagfish, but even yet some of its habits are unknown. For example, we do not yet know where it spawns, nor when.—*Science* (New York), vol. 61, pages 68-70 (Jan. 16, 1925).

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### *A Book for the Fundamentalist*

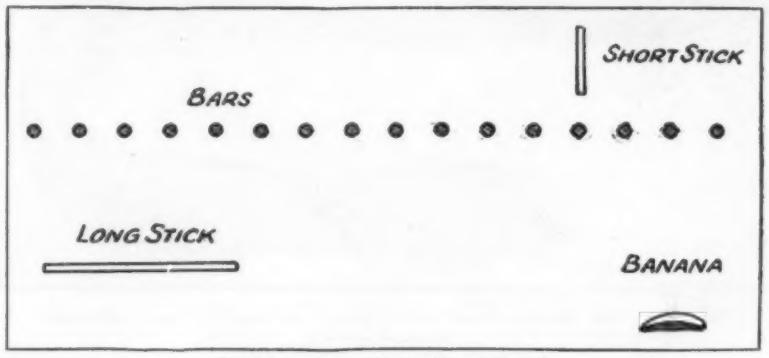
How many of the fundamentalists and anti-evolutionists have ever made a serious study of the arguments for, as well as against, evolution? Most of them assume that evolution means that man descended from monkey, but how many of them have ever made a serious comparative study of the anatomy of man and the apes?

In a new book, "*The Morphology and Evolution of the Apes and Man*," written by Dr. Charles F. Sonntag (John Bale, Sons and Danielsson, Ltd., London, 1924), there is presented for the first time in complete

form a plain description of all the parts of the skeleton, muscle system, internal organs and nervous system of man, the monkeys and especially of the four anthropoid apes; that is, the gibbon, the orang, the chimpanzee and the gorilla.

Dr. Sonntag does not argue; he merely presents the facts about the anatomy of the primates, just as these facts have appeared from dissections. For example, in one chapter he describes the skeleton and teeth, first of the gibbon, then of the orang, the chimpanzee and the gorilla. He compares these parts with the corresponding parts in man. Here is where the anti-evolutionists might find some encouragement in, for most but not all, of man's anatomical parts have their homologues in some or all of the apes.

We cannot advise everyone to read this work. It is somewhat technical. The anatomical terminology will be wholly understood only by one having special training in anatomy. Yet any intelligent reader may glean from this work enough to give him an adequate and well-proportioned sense of the anatomical relationships indicated by the bodies of man and the apes.




**Could an ape solve this problem?**

Perhaps the most interesting details treated are the blood tests which show how close to man the various primates stand on the tree of evolution. There is interest also in the comparative treatment of the ductless glands; the brain (the chief anatomical detail in which man surpasses the apes) and the ears.

* * *

### *Do Apes Reason?*

Of the four anthropoid or man-formed apes the psychology of the chimpanzee approaches most closely to that of man. The chimpanzee is familiar to most of us because he has become a motion picture performer. Before the camera he does things that astonish us, because they are things which we are accustomed to seeing only human beings do. Few, however, of these man-like performances of Hollywood apes are, scientifically regarded, true ape acts. Instead, they are only human actions taught to apes, a sort of human veneer on chimpanzees.

Science wants to know, however, how untrained or natural chimpanzees do act and think. Wolfgang Köhler, Professor of Philosophy in the University of Berlin, spent a number of years studying a group of seven chimpanzees housed in ample space on the island of Tenerife. In "*The Mentality of Apes*" (Harcourt, Brace and Company, Inc., New York) Professor Köhler gives full and detailed accounts of scores of mental tests on chimpanzees—problems and other obstacles of a psychological nature which he caused these seven animals to solve.

When one finishes reading over 300 pages of such accounts the general impression received is that while the things chimpanzees do without specific human tuition are very different from those done under specific human tuition, they are just as interesting, and they display fully as much intelligence in their way as the ape-human performances would denote, even if they were genuinely and purely ape performances.

For example, would it be more interesting to see a chimpanzee smoke a pipe when you knew absolutely that this was only a man-trained performance, than it would be to see one without any training whatever remove a sliver from your hand? "Two finger-nails are pressed down on either side and the splinter levered upwards, to be caught and removed by the teeth," writes Professor Köhler. "At the risk of infection, I went to a chimpanzee on one occasion when I had run a splinter into one of my fingers and pointed it out to him. He examined the wound, seized my hand and forced out the splinter by two very skilful but somewhat painful squeezes with his finger-nails; he then examined my hand again, very closely, and let it fall, satisfied with his work." Incredible, until one discovers that chimpanzees are very conscious of their skins and perform any such operation with pleasure.

Professor Köhler created all sorts of obstacles to the attainment of food prizes by his family of chimpanzees. He began with easy tests and progressively introduced harder ones. As a result of these tests he discovered that chimpanzees differ in their innate capacity to reason and to overcome mental obstacles. He believes they differ to just about the same extent as human beings do, for some are especially intelligent while some are rather stupid.

Given a stick of sufficient length, a chimpanzee of average intelligence will use it as an extension of his arm to draw toward him a piece of fruit which owing to the bars of his outdoor runway he cannot otherwise reach. Would he, however, be able to formulate the necessary mental picture in advance to enable him to make use in a similar manner of a short stick to draw toward him a long stick which would *in turn* enable him to reach the coveted prize? (see cut) The chimpanzee, Sultan, solved this puzzle. "He picks up the little stick, once more goes up to the bars, directly opposite to the long stick, scratches it toward him with the auxiliary, seizes it, and goes to the point opposite to the objective, which he secures. From the moment that his eyes fall upon the long stick, his procedure forms one consecutive whole." Nueva and Grande each passed the same test, but Tschego failed—perhaps he was a moron ape!

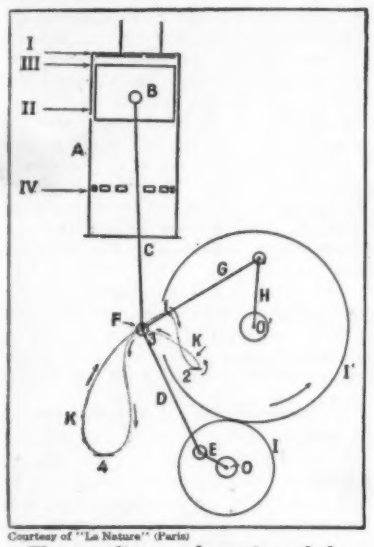
In other tests of a generally similiar but more difficult nature Professor Köhler's chimpanzees acquitted themselves, in the main, just about as they did in the test just described. They taught themselves to pile boxes on top of other boxes in order to reach bananas suspended from overhead. Sultan discovered that a stick having a longitudinal hole bored in one end could be extended enough to reach the distant prize by inserting in this hole another stick. Later he learned how to reduce the diameter of the end of the smaller stick enough to make it fit into the larger.

These acts seem remarkable and some will doubt whether they were performed without human assistance. Professor Köhler, however, is well on his guard against this tendency. Inspired dilettanti, he says, have asserted marvels of animal behavior. (In America, we call these inspired dilettanti nature fakers.) As a reaction from too much nature faking there has now arisen among animal psychologists a distinct negativist tendency; it becomes correct to establish mechanically limited actions, stupidity in animals. The pendulum swings too far the other way, Professor Köhler believes. "Unfortunately," he says, "there are still those who, for various emotional reasons, wish to find these qualities in the higher animals. I have tried to be impartial."

### *Andreau Variable-Stroke Engine*

A MOST ingenious method of overcoming some of the losses inherent in the Otto or four-cycle gas engine, has been devised by M. Andreau, for which he has been given the annual Jean Barès prize, awarded by *L'Office Nationale des Recherches et des Inventions*, for the best invention of the year.

In the diagram below, two crank-shafts, O and O', are geared with a ratio of two to one. From the crank pin of each, equal links are interposed to the crank end of the connecting rod, F. The motion of this point F on the sketch below is most interesting.

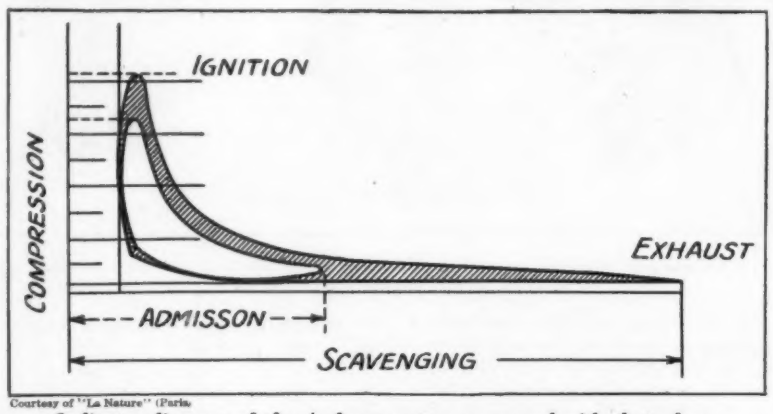



Courtesy of "La Nature" (Paris)

**The peculiar crank motion of the new French motor**

Here we find the scavenging stroke is being completed. The admission stroke causes F to follow the arrows through the indicated irregular path to 2 (II on piston displacement diagram), which is the low point of the admission stroke—approximately 45.6 percent of the full working stroke—when compression takes place to 3 (III of piston diagram). Ignition occurs and the working or power stroke faces F to 4 (IV of piston diagram), where exhaust takes place through ports in the cylinder wall and the exhaust valve in the cylinder head. Scavenging is completed through curve K, by lengthening the stroke, thus completing the cycle.

The advantages apparent are:




Courtesy of "La Nature" (Paris)

**Indicator diagram of the Andreau motor, compared with that of an ordinary motor**

1. Scavenging through exhaust ports in the cylinder wall at the end of the working stroke and by the exhaust valve throughout the exhaust stroke, completely scavenging the cylinder. Clean, fresh gas for the power stroke is thus obtained, unmixed with the residue of previous combustion.

2. Short admission stroke with consequent reduction in the temperature of the charge and resultant low compression necessary.

3. Long working stroke utilizing the maximum power of the charge, complete afterburning, and so on.

4. Direct power thrust. Note that in the power stroke, F travels closely along the projected axis of the cylinder. The side thrust comes in both instances when there is no power against the face of the piston.

5. The links are so arranged that there is no dead centre in any position of the mechanism.

6. Economy of fuel resulting from 1, 2 and 3.

7. Low heat of cylinder walls resulting from 1, 2 and 3, thereby facilitating air cooling.

Official tests of 1,500 hours' duration, were made at the *Laboratoire des Arts et Metiers*., with a speed limit of 1,700 revolutions per minute.

The dimensions of the engine tested were:

| | |
|---|---|
| Bore | 2.95 inches |
| Admission Stroke | 2.03 inches |
| Compression Stroke | 1.70 inches |
| Power Stroke | 3.05 inches |
| Exhaust Stroke | 3.85 inches |

* * *

### *Two Dancing Electrons the Secret of Color*

THE secret of the cause of color and of why dyes dye is to be found, according to Professor Julius Stieglitz, of the University of Chicago, in the dance of two tethered electrons attached to a carbon atom. This original theory was explained and illustrated in one of the sectional sessions of the recent Franklin Institute Centenary.

Professor Stieglitz dissolved a white powder in a glass and by adding to the solution liquids which were equally colorless the contents of the glass changed successively to yellow, to red, to brown and to black while the lantern projected on the screen the carbon chains and rings of the structural symbols of the dyes produced.

What was happening, it appeared, was a loosening up of a pair of electrons belonging to one of the carbon atoms so that they could vibrate in tune with the light waves received by the substance.

The waves at the violet end of the rainbow spectrum were easiest to absorb and the light that was left to be perceived by the eye belonged to the red and yellow end of the spectrum. By giving the electrons a little greater freedom of movement they were able finally to respond to all the wavelengths and so to absorb all the light, thus leaving the liquid black and opaque. This phenomenon occurs because the color that we attribute to an object is not the color that it catches out of the light and holds, but the color that it rejects and returns to our eyes.

Now, according to the Stieglitz theory, all dyes and pigments are so constructed as to have a positive atom which is short of electrons closely adjacent to a negative atom possessing a surplus of planetary electrons, and the pull of the positive atom on these electrons sufficiently detaches them from their allegiance to the negative atom to enable them to vibrate to the stimulus of the passing light waves just as the strings of a piano "echo" the sound waves of the air.

# Learning to Use Our Wings

*Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes*

**Conducted by Alexander Klemin**

*Associate Professor of Aeronautics, New York University*

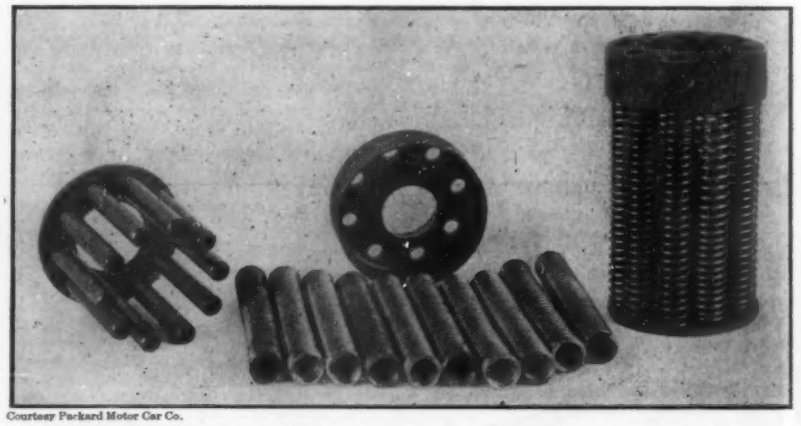
## Inverted Engines

THE idea of inverting the engine of an airplane is not new, but it is only recently that serious attention has been given to its possibilities. Captain L. M. Woolson, writing in the Journal of the Society of Automotive Engineers, summarizes the advantages obtainable. The pilot's vision is greatly improved because the wide upper part of the V engine no longer obliges him to swing the airplane from its true course to obtain a view along the normal line of flight. With inversion the propeller thrust line is higher. An airplane which is balanced for a glide without power generally becomes tail heavy with power on; the thrust being now raised above the center of gravity combats the tail-heaviness.

The third point in favor of the inverted engine is its accessibility to a mechanic working on the ground, eliminating the necessity for step ladders or other equipment. Also the carburetors can be placed so low that a simple gravity feed for the gasoline becomes often possible, doing away with the complexity of gasoline pumps. It is not impossible that the inverted airplane engine may become generally accepted practice.

## Cluster Valve Springs

A REGIMENT of soldiers marching over a bridge can break it down, if the period of their step happens to synchronize with the natural period of vibration of the bridge. The phenomenon can be illustrated easily by suspending a weight at the end of a string. If the weight is struck the gentlest of blows each time it swings through the lowest point, and the blow always coincides with the direction of the swing, the weight will soon be moving through a very wide arc.



Courtesy Packard Motor Car Co.

**The natural vibration period of these springs is too fast for the vibration period of the engine to break them**

Frequent trouble has been experienced in high-speed engines owing to the synchronism of the firing impulses with the vibration of the valve springs, with failures as a result—and these failures are apt to be disastrous because the valves may drop into the combustion chamber and wreck both piston and combustion-chamber head. The remedy is to make the period of vibration of the springs much faster.

In the previously mentioned paper by Captain Woolson an ingenious solution is described. Instead of one heavy valve spring of the usual type, a multiple-cluster type of spring is used. This consists of a group of seven to ten, small diameter piano wire springs arranged in planetary fashion round the valve-stem. Of lighter wire and smaller diameter of coil these springs vibrate three and one-half times as fast as the ordinary valve springs and are "out of step" accordingly with even the fastest engine.

## The Los Angeles Corroded

THE Navy continues to employ the Los Angeles in a series of extremely valuable experimental trips. The trip to Bermuda was only partially successful—our readers will recall that a heavy downpour of rain made the airship too heavy to land at the islands, although the Los Angeles was able to navigate in extremely unfavorable weather. It taught the Navy engineers, however, a very valuable lesson. Anticipating possible freezing in the water ballast or in the exhaust-gas, water-recovery system, they had placed calcium chloride in the tanks and piping.

Leakage of the chemical caused serious corrosion of the duraluminum structure, and led to a worth while remedy. Whether by careful precaution against leakage or by the use of another chemical is not yet decided.

## Shenandoah's Cook Stove

ACCORDING to U. S. Air Services the Shenandoah is to be equipped with an aerial cook stove for future operations. Designed for use in the air where weight is all important, it weighs only 219 pounds complete with utensils, is of small overall dimensions, yet supplies the entire crew with cooked meals. It is capable of providing a temperature of 450 degrees, Fahrenheit, the heat being kept within the oven by walls one inch thick of special insulating material compressed to a high density.

Before the installation of the stove rudimentary cooking arrangements over the engine exhausts had to suffice. Now the men will have meals the equal of anything the Navy can provide on shore.

## Dropping the Undercarriage

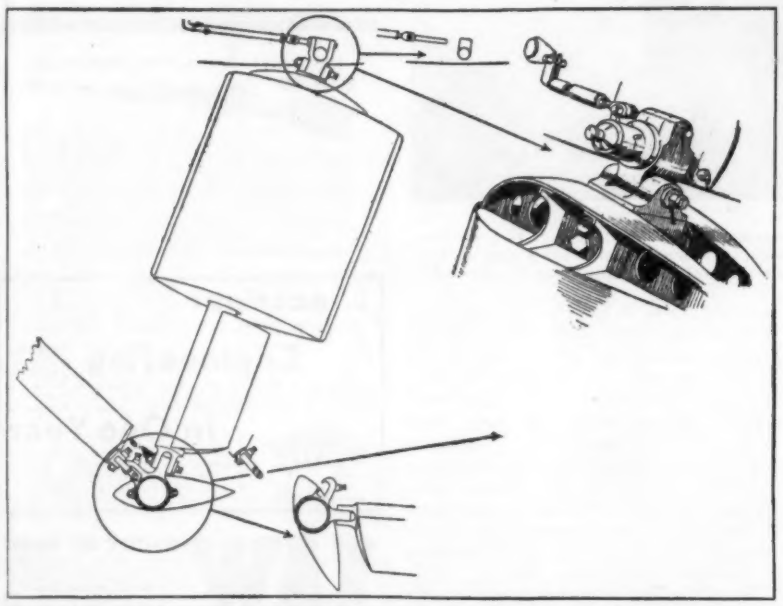
LANDPLANES are lighter and more efficient than seaplanes, and with only the twenty-mile strip of English Channel between France and England it is perfectly clear why landplanes are always employed. They have the disadvantage of giving the plane and passengers a bad ducking if the engine fails when the plane is too far from shore to glide to land. The English have made experiments with water-tight fuselages. But the provision of a water-tight fuselage did not insure the flotation of the machine, because the plane was found to trip over the landing gear when striking the water and nose over.

The De Havilland Company in their new 600-horsepower London to Paris passenger plane have got round this difficulty by providing a droppable undercarriage. This is

shown in the drawing we reproduce from the *London Aeroplane*.

There are as usual two landing-gear struts on each side of the airplane. The rear strut of each pair is a telescopic one, closing up against the action of rubber cord and thus providing shock absorption. The top of the telescopic leg is attached on the side of the fuselage by a universal joint block. This block is slotted away on the top side so that it will fall clear of the fuselage attachment when the machine is in the air unless a filling block which fits the slot is in position and is locked there by a pin. The pin is coupled by a system of links and a rocking shaft to a lever in the cockpit, so that it can be withdrawn at the will of the pilot. The rear or telescopic leg then falls, and together with the axle and wheels, swings round a hook joint which attaches it to the front undercarriage leg. When the telescopic leg has come to a horizontal position the hook disengages and the leg falls free.

When the plane hits the water the front legs are now free to swing upward, and



**A system of links and a rocking shaft enable the pilot to withdraw a pin which releases the rear strut of the landing carriage on either side of the fuselage. The rear strut swings round the hook joint shown at the bottom of the diagram, until it reaches a horizontal position when it swings free**

though the hot engine may be damaged by contact with cold sea water, the plane will float indefinitely till some boat picks it up.

### The Airman's Slang

THE young officers of the Army Air Service have developed a vocabulary all their own, almost unintelligible to the layman.

An Air Service officer who cannot fly, is a "keewee," a name derived from that of the Australian bird with undeveloped wings. When one becomes confused in conversation, he is referred to as being in a "flat spin." A speaker orating at undue length is given a kindly hint that he must "land" by the placing of two matches in T form, outlining the wings and body of a plane. "Ceiling" is the highest point an airplane can reach depending on its horsepower and the air density. "Archie" is the endearing term that fliers have for all anti-aircraft guns. "Give 'er the gun" and "set her down" are self-evident expressions. "Cracked up" means a wrecked plane and "washed out" is the semi-humorous term that covers deep regret for a comrade who has perished in flight.

### A Speedy Fall

TO make a successful jump an aviator must above all get his parachute clear of the plane. The theory has been held in practical aviation circles that a plane with its heavy engine might fall faster than the man and strike him after the jump! Yet a man is relatively much bulkier than a plane and his body is a cylinder not likely to provide the sustention that airplane wings will give even under unfavorable presentation to the air.

It is not surprising, therefore, to read in the *New York Times* that recent tests at the Army Air station at Mitchel Field, Long Island, have effectively dispelled this notion. When Lieutenant M. E. Elliott put his heavy De Haviland plane, equipped with a 400-horsepower Liberty motor, into a fast tail spin and lost altitude rapidly, two enlisted men who jumped off the wings beat the ship most thoroughly in the curious race downwards. Incidentally they dropped 1,500 feet before pulling the rip-cord of their parachutes, demonstrating anew the wonderful faculty man has of retaining complete consciousness under the trying conditions thus obtaining.

### Mid-ocean Airdrome

A FRENCH plan for airdromes anchored in mid-ocean has been described in these columns. The idea seemed to savor of Jules Verne. Yet if the new Navy seaplane squadron is successful in making a non-stop flight of 2,048 miles from Honolulu to San Francisco, it is proposed, according to the *New York World*, to anchor a refueling station midway between these two points.

### Pointers in Mail Planes

THE Air Mail Service competition for the purchase of a new plane has brought forth nothing revolutionary in design. But some interesting improvements in detail bring us nearer to the era of entirely practical aircraft. For example it is very disconcerting to lose aileron or lateral control. In the Aerial Mercury described in *Aviation*, ailerons are mounted on the top and lower wings of the biplane and their control is so arranged that even if one aileron is carried away or a control cable breaks, control is still maintained over the other pair of ailerons.

In night flying permanent lights mounted on the instrument board are apt to dazzle the pilot. In the Aerial Mercury a convenient switch is placed at the top end of the control stick so that the board is illuminated only when illumination is required.

Flying at night in the heart of winter is a cold proposition; accordingly a branch taken from the exhaust pipe of the engine carries hot air around a flexible pipe of large diameter, placed in the pilot's cockpit, and gives heat controlled by a valve within easy reach.

Nothing troubles fliers so much as leakage in the water system; suspension of the radiator below the engine entirely on rubber

will remove vibration and one cause of water leakage.

In the ordinary landing gear shock absorption is provided by strands of rubber cord, subject to rapid deterioration; in the new mail plane shock absorption is provided by disks of soft rubber acting in compression, which give every evidence of long life. The cumulative effect of these apparently minor improvements is extremely important.

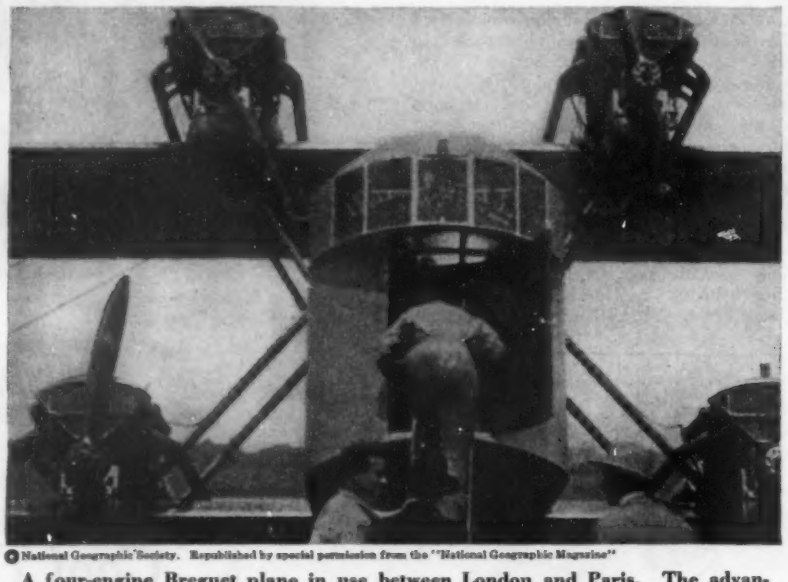
For the flight from Toulouse, France, to Spanish Morocco and return the distance of 2,360 air miles was flown at a cost of $84, or three and one-half cents a mile. If the cost of sleeping accommodation and meals on trains or boats is included, the travel by air in many instances is actually more economical than first-class passage by any other means.

The total flying time in Lieutenant Van Zandt's trip was 73 hours for the 6,500 miles or an average speed of 89 miles. The two principal reasons for the low cost of this air tour, however, were the generally favorable rate of exchange and the government subsidies granted to the air lines, which cover a portion of the expense of operation.

The traveler brought back with him many wonderful photographs from the air, memories of wonderful views, and strange stories of contact with many peoples. But on the whole the impression of the trip is that flying is almost a commonplace now.

When traveling to Bucharest, and already beyond the Transylvanian Alps, Van Zandt complains of having to travel at a snail's pace of 75 miles per hour—there appears to be a curious speed-saturation in flying. Fogs, rain and thunderstorm encountered on the trip never seemed to bother the pilots and planes of various nationalities.

Croydon with its imposing row of offices



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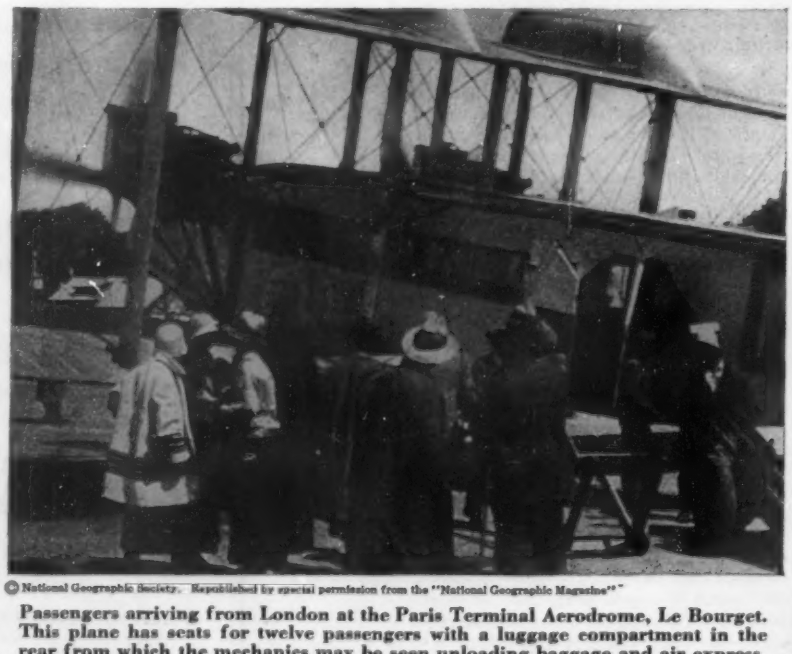
**A four-engine Breguet plane in use between London and Paris. The advantages of a multiple power plant are obvious. Passengers and pilot may enter by the door in the nose of the fuselage or through a similar door in the side**

## Looking Down on Europe

LIEUTENANT J. Parker Van Zandt, writing in the *National Geographic Magazine*, describes in fascinating fashion a wonderful air tour of Europe, as a passenger on English, French, Rumanian, Polish, German, and Dutch air lines.

Starting from the Croydon Aerodrome in London the gallant officer covered some 6,500 miles in the air.

Apparently the whole of Europe is now served by practical, every-day aerial services. Nor is the cost of such travel excessive; it is roughly equivalent to first-class passenger travel by rail.



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**Passengers arriving from London at the Paris Terminal Aerodrome, Le Bourget. This plane has seats for twelve passengers with a luggage compartment in the rear from which the mechanics may be seen unloading baggage and air express. The engines are 350-horsepower Rolls-Royce motors. On the upper wing may be seen the gasoline tanks from which the fuel reaches the engines by gravity**

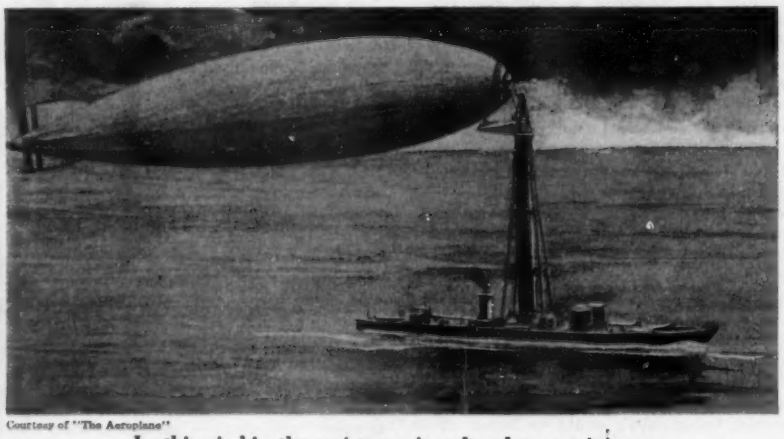
The actual cost of air tickets for the total 6,500 miles was $380 or between five and six cents per air mile. It is to be remembered that almost invariably the ground distance between two points is longer than the air distance, a further advantage for the more modern form of transportation.

and waiting rooms of the British, Dutch and French services gave the impression of a typical railway station. With thousands of airplane flights between London and the Continent there are strange to say only two instances of planes being lost in the Channel. In one of these cases it is believed that the pilot was shot by an insane passenger and regulations were thenceforth issued prohibiting passengers from riding in the cockpit with the pilot. Most of the passengers arriving from London at Le Bourget in Paris appeared to be Americans, unconcerned and happy tourists.

Van Zandt, besides getting photographs and stories of interesting happenings, brought back immensely valuable information and reliable statistics of air transportation. For example, his study of European commercial air services indicates that financial paper, merchandise and freight of all kinds may often be transported by air with greater safety from loss or damage than by the usual channels of boat or rail. The insurance rates, for example, for all risks including theft, on articles such as dresses, furs, jewelry, fragile goods, and so on, between London and Paris or Amsterdam are several times less by air than by boat and rail. Much gold bar and silver are shipped across the channel by air, one plane alone having carried $2,009,000 worth.

In the five years from 1919 to 1923 inclusive, the aggregate number of air transport miles flown was 20,110,700. It is estimated that this has been increased by 8,500,000 during the year 1925. In 1919, the number of passengers carried was 2,585. In 1924 it was 62,000 with a steady growth in the intervening years. Goods traffic has now grown to enormous proportions with 5,400,000 pounds transported during 1924.

In the course of his report Van Zandt points out that European nations are faced with a fundamental political difficulty in the development of air lines, because the principal lanes of business involve flight over several countries. The United States on the other hand is probably better suited politically to the establishment of self-supporting air lines than any other country in the world by reason of its geographical extent, freedom from custom restrictions, and common national interests.



Courtesy of "The Aeroplane"

**In this airship the resistance is reduced to a minimum**

## Reducing Airship Resistance

A WELL streamlined form of airship hull has a resistance only one-fiftieth of that of a circular disk of the same area perpendicular to the wind, and leaves but little to be desired in the way of further reduction of resistance. The same is not true of those parts of the airship which are external to the hull, and which may actually have double its resistance.

The Airship Guarantee Company which is to build an airship of 5,000,000 cubic feet for the British Air Ministry proposes to reduce these resistance producing externals by placing the control cabin in the very nose of the ship, carrying all control wires internally and enclosing the passenger car entirely within the envelope, leaving nothing but engine gondolas outside the hull. In the case of this particular design it is estimated that an increase in speed of ten miles per hour will result, raising the maximum speed to eighty miles per hour, or alternatively increasing the radius of action at the same speed by fifty percent.

## Outlook for Civil Aviation

WRITING in Commerce Reports of the Department of Commerce, P. E. D. Nagle makes some pertinent observations on this subject. Russo-German services to the Caucasus and Siberia, the methodical planning of a British service to India and Australia, and the activity of French companies in arranging a French-South American service via Spain, Morocco and Senegal, show the wide extent of the field to be covered and the rapidity with which international services are expanding.

Mr. Nagle admits that American civil aviation is faced by three serious obstacles: high operating costs; lack of air legislation or regulation; and, finally, lack of public interest. Yet the extent of our own country, its physical characteristics and its intimate contact with Canada, Mexico, and the West Indies make air services extremely desirable.

## Steam Power for Aircraft?

ANYONE who has traveled on an ocean liner knows the perfect reliability of a steam power plant. The use of steam for aircraft has been suggested again and again on the score of this reliability. Writing in the *Aeronautical Journal*, J. D. Siddeley doubts the feasibility of the idea.

He points out first of all that great reliability in steam power plants on shipboard has been obtained without regard to weight limitations, with a weight power ratio of something like 200 pounds per brake horsepower. If applied to aircraft the steam engine would have to be ruthlessly cut in its bulk and weight for a given power and its reliability might not be as great as in the liner.

From a detailed investigation it would, nevertheless, appear that a complete power plant designed specially for aircraft with an output of 1,500 brake horsepower might have its weight ratio reduced to four pounds per horsepower. Such a plant would involve a special type of flash boiler, a high-speed turbine unit embodying a reduction gear to obtain a suitable propeller speed, and a condensing unit. In addition the plant would necessarily comprise auxiliaries, such as means for inducing draught, fuel pumps, condensing pump, and so on.

The steam power plant would, therefore, become bulky and unwieldy. The aerodynamic resistance of the condensing unit—since the rush of air alone could be used for condensing purposes—would become very great, and the thermal efficiency would be only fifteen percent as compared with a possible thirty percent for an internal combustion engine.

The steam power unit would offer the advantages of the ready use of a heavier grade of oil than gasoline and also the fact that its power would not decrease with altitude. Nevertheless its limitations are such as to render its use difficult.

# Science and Money

## Patent Rights as an Investment Basis

*By John K. Brachvogel*
of the New York and Washington Bar

WITH the possible exception of gold or oil, there is nothing which so strongly intrigues the interest of the potential investor as patents. And when we stop to think that at least three-quarters of the industrial wealth of the United States is based directly or indirectly upon patent rights, there is every reason for this. Some of the very greatest of our industrial organizations sprang from the commercial exploitation of a patented invention. It is true that these great businesses, such for example, as the International Harvester Company, have far outgrown and have long outlived the original patent or patents which created them, but with the rise of such organizations has come the development of manifold other and allied patented inventions, which, while they cannot increase the lives of the original patents, all help to foster the growth of the industry and in themselves are substantial values to back the securities which represent the assets of the corporate organization.

The value of patent rights as part of the physical property of corporations whose securities are marketed, is thoroughly recognized not only by the investing public, but by the promoters and officers of the corporations in question. Of this there can be no doubt, and yet as patent rights are more or less intangible and are difficult to evaluate in dollars and cents, the great industrial corporations differ as to the listing of patent rights among their properties. One of the greatest organizations of its kind in the world, which owns patent rights worth many millions of dollars, values the same in the listing of its assets at one dollar. A great competing corporation, also the owner of patents rights worth many millions, assigns to them in its annual statement a fair and approximate valuation of so many millions. It would thus seem that the investor considering purchasing the stock of either one or the other of these corporations, all other factors being equal, would be better off in placing his money in the stock of the first because, in the case of that one, its extremely valuable patent rights are, to use the vernacular, "all velvet," and if in purchasing the stock of this corporation, he makes a careful scrutiny of the book value of that stock, it would be based not on the patent rights of that company, but on its other tangible property rights, and the value of the patents would be just so much in addition.

The investment of money in patents is, it must be admitted, to a large extent a gamble, unless those patents have been tried in the fire of practical exploitation, and in many instances the test of fire in the courts. While unquestionably our patent laws are an admirable instrument in fostering the creation of new ideas and the development of industry, patents lend themselves readily to fraudulent uses. This is due to the fact that patents, like people, are good, bad and indifferent. Furthermore, a valueless invention, from the practical standpoint, may have sufficient novelty to be accorded broad patent protection. Again a valuable innovation may be so slight a step forward in the art that a patent to cover it must necessarily be very limited, yet such limited patent, if the specific and limited invention is in itself the only solution of the problem in question, may be all that is necessary, and in that case even the limited patent gives that mead of protection which will answer the purpose. How true this is is well illustrated by the instance of the Sulman-Picard-Ballot patent for a Process of Oil Concentration of Ores, which was extremely limited in that it covered merely a specific percentage of the oil used, and which was regarded by most patent attorneys as invalid for that reason. Nevertheless, the Supreme Court of the United States, because of the outstanding practical results accomplished by this patented process, upheld the patent, with the result that its owners were paid many millions of dollars for the use of the process.

The world of industry is replete with great successes founded on patent rights. It is also replete with stories of the difficulties of inventors of outstanding advances in industrial development in marketing the securities based on their patents. Workmen stringing telephone lines for the original Bell Company, who were paid in stock of that company because there was no money available, jokingly tacked the certificates on the telephone poles and left them there. It takes no stretch of the imagination to think what those certificates would be worth today. Ford, who had no money to pay his patent attorneys, made them rich because they were willing to take stock in the original Ford Company for their services. Eastman was nearly driven insane by his efforts to raise his first three hundred thousand dollars to found what is now the great Eastman Kodak Company. Innumerable examples could be added.

On the other hand, we have the fly-by-night promoter who fattens on the credulity of the general public and its belief that a patent is something sacred. How often do we see in some shop, rented perhaps for a month, a model on display, say of an automatic train-control system. Pretty little railroad cars are running on a track and stopping automatically as the nicely made signals electrically operate. Inside is the usual "fake" stock salesman. The original copy of the patent is elaborately framed and hung on the wall. Beautifully illustrated prospectuses, speaking in glowing terms of the solution of the great railroad problem of complete and effective automatic train control, are handed out to the gullible. How much fake stock is sold in this way can hardly be computed. It is sold in small lots, perhaps a share at a time, to the poor and the ignorant. After the field has been harvested, the promoter of the enterprise, who usually operates just within the law through some corporate organization, capitalized for perhaps several million, the stock being issued against the patent or patents—and remember almost anybody can obtain some kind of a patent on an invention of this kind—disappears and resumes operations in some other city. We cannot too strongly emphasize the necessity of caution in the purchase of securities offered for sale in this or some similar manner.

No empirical rule can be laid down governing investments in securities based upon patent rights. Where the sole property back of the securities is the patent rights in question, great care should be exercised in ascertaining just what those patent rights are; how sound the patents themselves are, and how far reaching in the degree of protection they afford. In addition, the investor should make sure that there are no prior and controlling patents which might be infringed, for it is perfectly true that an entirely valid patent may be issued which in itself may cover a valuable invention, and yet the subject matter of that patent may infringe some earlier patent.

In any event do not invest your money in an enterprise merely because of a patent unless it is certain that the patent is all that is claimed for it, and remember, too, that it takes skill, experience, and technical and legal knowledge properly to pass upon a patent. It is needless to say, on the other

hand, that sound patent rights are of the greatest value in innumerable cases. All the great corporations in the scientific and industrial field are fully aware of this. Many of them have corps of trained inventors, the patented output of whose efforts becomes the property of the corporation which they serve. As patents grant monopolies for the periods of their lives, they are obviously of value to their owners and can honestly be regarded as important factors contributing to the underlying value of the stock of the corporation controlling them, but it must be emphasized again that in cases where the patents *alone* are the basis of the stock value, they must be scrutinized with great care from every possible angle.

## Science Notes

### Again the Question, Environment Versus Heredity

IN The Scientific Monthly for September, 1924, Professor H. S. Jennings of Johns Hopkins University has an extremely interesting article on Heredity and Environment in which he criticizes adversely most current interpretations of the Mendelian Law, and finds much more of a place for the effects of environment than is usually granted at the present time.

What a young organism is first composed of, say Professor Jennings, comes directly from its parents. This is the reason why dependence on that composition has been called heredity. But this habit of speech had led to conceiving heredity as something in itself, an entity, a "force," something that itself does things. This is an error that has induced clouds of misconception.

Continuing, Professor Jennings says: As to the dependence on the stuff that young organisms are made of, research has shown that the substances passed from parent to offspring, giving rise to the phenomena of inheritance, are a great number of discrete packets of diverse chemicals, imbedded in a less diverified mass of material. The masses formed by the grouping of these packets are visible under the microscope as the chromosomes.

The number of different kinds of these packets that go into the beginning of any individual is very great, running into the hundreds or thousands. They are not massed in a haphazard way, but are arranged in a definite manner; so that the young organism is like a well-organized chemical laboratory with many reagents so arranged in containers as to react with each other in an orderly way, producing a definite and harmonious result.

Development consists in the orderly interaction of these substances—with each other, with the rest of the cell body, or cytoplasm, and with the oxygen, food and other chemicals brought into the cell from outside, but all under the influence of the physical agents of the environment. The final result—what the individual becomes—is dependent upon all these things and a change in any of them may change the result.

Substituting one or more packets for others is found to change the characteristics of the organism produced, different sets giving when they develop, even under similar environments, different physical, mental and moral peculiarities. The first precise discovery made was, essentially, that when a single one of the packets is exchanged for another, some definite later character is changed. Therefore, changing one packet alters the color of the hair from black to red, or changes the eye color from blue to brown, or makes the organism short instead of tall, or even changes a person from a normal individual to a feeble-minded one or the reverse. Characters changed by altering a single packet were the so-called "unit characters" of Mendelism.

These facts—the relation of single packets to particular later characteristics—gave rise to a general doctrine, a philosophy, of heredity and development, a doctrine which has had and still has a very great influence on our general views of life. It is to this doctrine that the prevailing ideas as to the relation of heredity and environment, and as to the relative powerlessness of environment, are due.

But this theory of representative particles is gone, asserts Professor Jennings. Advance in the knowledge of genetics has demonstrated its falsity. It is not true that particular characteristics are in any sense represented or condensed or contained in particular unit genes. Neither eye color nor tallness nor feeblemindedness, nor any other characteristic, is a unit character in any such sense.

What recent investigation has shown is this: the chemicals that were in the original packages derived from the parents — the genes—interact, in complex ways, for long periods; and every later characteristic is a long-deferred and indirect product of this interaction. What any given cell shall produce, what any part of the body shall become, what the body as a whole shall become, depends not alone on what it contains—its "heredity"—but also on its relation to many other conditions; on its environment.

In illustration of this fact appeal is made to recent work in embryology. In fishes, for example, two eyes, one at each side of the middle line, form as distinctly an inherited characteristic as in man, yet fishes can be subjected so early to changed conditions (as Stockard and others show) that the animal has a single median eye instead of two lateral ones. Many other equally striking changes are producible by changes in the chemical environment.

If the fish lived continuously in these conditions they would regularly inherit a single median eye. The two lateral eyes would be looked upon as a rare abnormality, produced by special conditions and not inherited. In truth, all characters are as certainly due to the *conditions of development* as to the materials of the germ cells.

As applied to human beings this means that, if there were not practical difficulties in the way, similar fundamental changes of structure could be made in man or any of the higher animals. In these higher creatures, a time comes, before development stops, in which it is possible to change the conditions; that is, after what we call birth. And then it is found that changing the conditions does change the characteristics that later develop exactly as the characteristics of fishes are changed by changing the conditions. Every creature has many inheritances. Which one shall be realized depends on the conditions under which it develops. But man is the creature that has the greatest number of possible heritages.

Or, more accurately, men and other organisms do not inherit their characteristics at all. What their parents leave them are certain packets of chemicals which under one set of conditions produce one set of characters, under other conditions produce other sets.

In man, the number of diverse sets that may thus be produced is very great; although it is of course not unlimited. But what the limitations are cannot be stated from general biological principles or from what we know of any other organisms; they can be discovered only by concrete studies of man himself.

Adequate recognition of these facts and principles, which appear fully established by the advance of genetics, would, Professor Jennings concludes, greatly alter some of the current discussions and attitudes on the relation of biological science to human affairs. The immigration problem is an example. Recent immigrants show certain proportions of defective and diseased persons. We are informed that "these deficiencies are unchangeable and heredity will pass them on to future generations." There is no warrant in the science of genetics for such a statement; under new conditions they may not reappear.

* * *

### Value of Tobacco Smoke as a Disinfectant

DURING the past fifty years the controversy between the friends of the "weed that cheers without inebriating" and their opponents has

led to extensive and careful investigations of the physiological effects of tobacco and, particularly of its principal active component, nicotine. Not until recently, however, has the disinfecting power of tobacco smoke been made the subject of specific research.

This investigation was undertaken by Dr. Georg Wolff, a noted German scientist, and the highly interesting results obtained were published in detail in the *Archiv für Hygiene*. In his laboratory the investigator rigged up an apparatus in which the smoke from a lighted cigar, cigarette or pipe was drawn by aspirator suction through one or more containers in which the smoke came in contact with smears. Smears are pure, developed cultures of various pathogenic microorganisms. It was definitely ascertained that inoculated media which, immediately after their inoculation by smears had been exposed to tobacco smoke, did not develop cultures of bacteria after subsequent incubation during a period of twenty-four hours, at a temperature of ninety-eight degrees, Fahrenheit. The control, media, inoculated at the same time, but not exposed to tobacco smoke, showed prolific cultures after such incubation.

Similar tests were made with the bacillæ of influenza, diphtheria, typhus, dysentery, and with the pneumococci, staphylococci, the vibrio of cholera and other pathogenic germs. In each case the result obtained was the same.

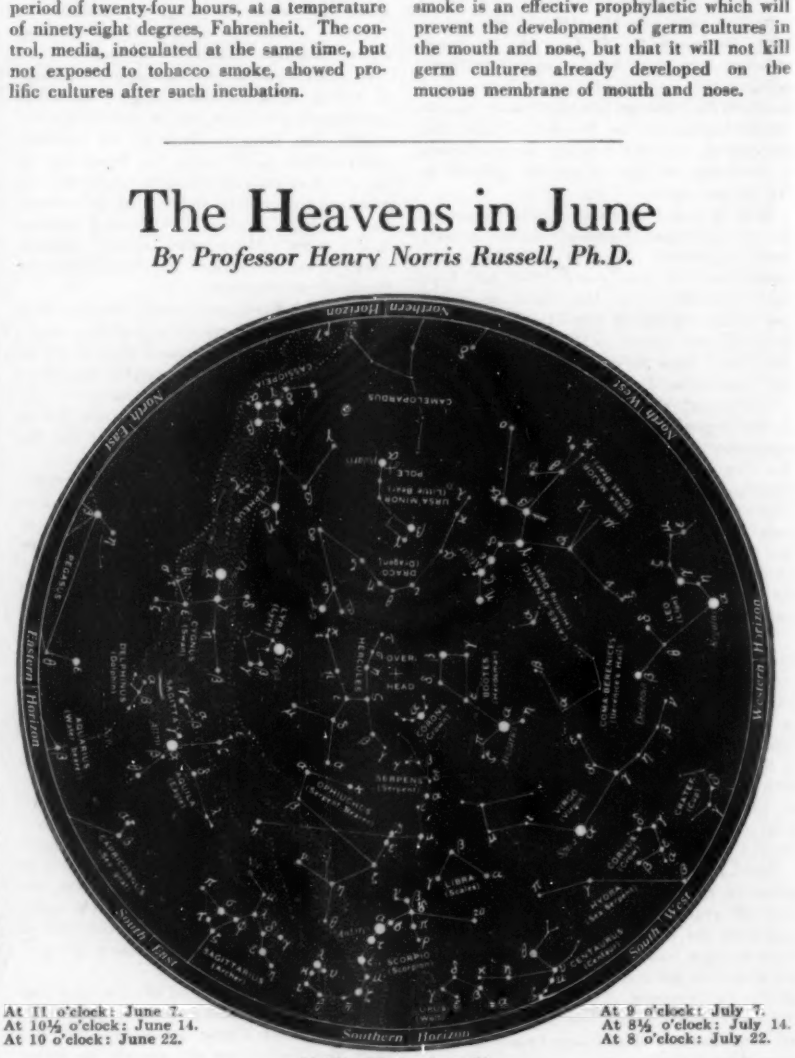
If the smoke was sucked through a cotton filter before it came in contact with the inoculated media, its power to prevent the development of cultures remained intact. But it lost this power completely if passed through water before reaching the inoculated media.

In a second series of tests the effect of tobacco smoke upon fully developed pure cultures of various microorganisms was investigated with the aid of apparatus similar to that just described. It was found that only the most sensitive germs, like those of influenza, were killed by the smoke, while the majority of the harder germs were not affected.

These results seem to prove that tobacco smoke is an effective prophylactic which will prevent the development of germ cultures in the mouth and nose, but that it will not kill germ cultures already developed on the mucous membrane of mouth and nose.

# The Heavens in June

*By Professor Henry Norris Russell, Ph.D.*




At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

**NIGHT SKY: JUNE AND JULY**

### The Heavens

THE finest part of the sky is now in the south and southeast, adorned by Scorpio, Sagittarius (with the great star-clouds) Aquila, Lyra and Cygnus, and also by the planet Jupiter. Cassiopeia and Cepheus are in the northeast; Draco and Ursa Minor in the north; Ursa Major in the northwest; Leo and Boötes in the west, and Virgo and Hydra in the southwest.

### The Planets

Mercury is a morning star at the beginning of June, rising a little before 4 A.M. He is soon lost in the dawn, and though theoretically an evening star after the 20th, he will not be visible until next month.

Venus is an evening star and becomes fairly conspicuous by the end of the month, when she sets at 8:40 P.M. Mars is also an evening star in Gemini and sets at 9:30 P.M. in the middle of the month. Jupiter is in Sagittarius and is not far from opposition, but is so far south that he rises only after 10 P.M. on the 1st and after 8 P.M. on the 30th. Saturn is in Virgo and crosses the meridian at 9 P.M. in the middle of the month. Uranus is a morning star in Pisces and is in western quadrature on the 17th, while Neptune is in Leo and sets at about 4 A.M.

The moon is full at 5 P.M. on the 6th, in her last quarter at 8 A.M. on the 13th, new at 1 A.M. on the 21st and in her first quarter at 5 A.M. on the 29th. She is nearest the earth on the 8th and farthest away on the 23d. She is in conjunction with Saturn on the 4th, Jupiter on the 9th, Uranus on the 13th, Mercury on the 21st, Venus on the 22d, Mars on the 23d, Neptune on the 25th.

At 5:50 P.M. on the 21st the sun reaches its northernmost point and "summer begins."

# Radio Notes

*A Review and Commentary on the Progress in This Branch of Rapid Communication*

**Conducted by Thomas Elway**

## Broadcasting from Mid-ocean

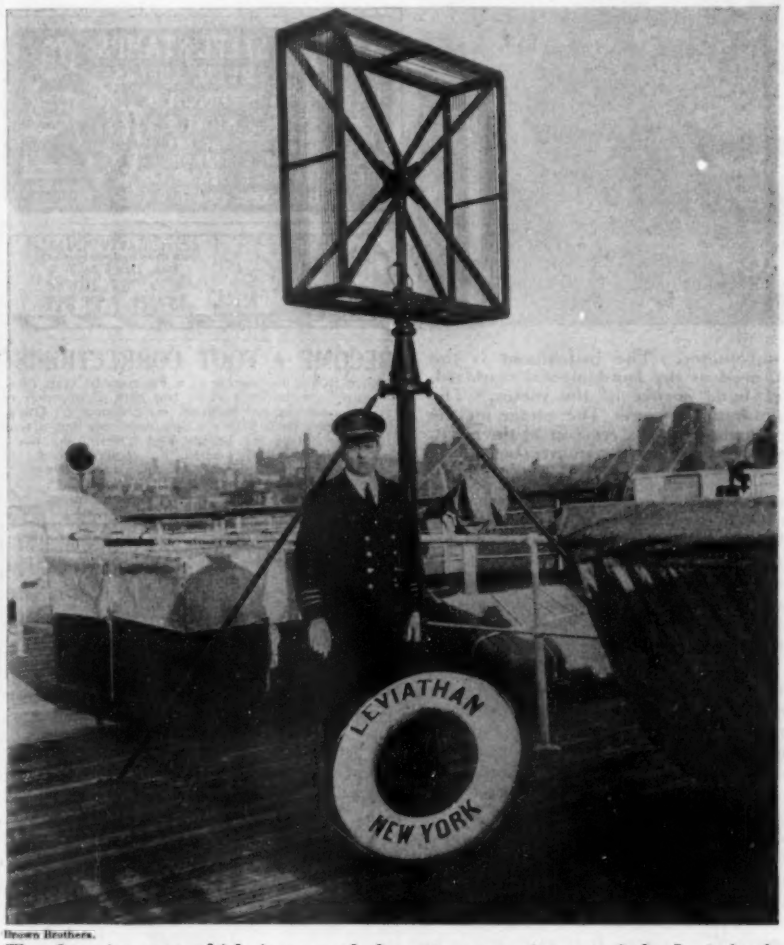
THE giant Steamship Leviathan, noted already for her unusually complete radio equipment, has added a new set of laurels to her wireless crown. She has actually begun broadcasting the many ship's concerts, entertainments, and other doings while plunging at twenty-four knots an hour through howling gales and hissing turbulent seas. The success of her experiments has been amply proven by the tremendous influx of mail from both sides of the ocean, addressed to her Chief Radio Officer, E. N. Pickerill, one of the veterans of the transoceanic trade.

The first reports of reception indicated that he had been picked up when only some eight hundred miles out of New York, by several English stations, who said that they had been able to dance by the music of the ship's orchestra, at the same time that the passengers were dancing in the vast ballroom on the palatial liner plowing her way toward the old world. Tube sets were successful at this distance, and in most cases ranged from three to five tubes.

transferred from a straight CW or interrupted CW telegraph set to an excellent telephone set. By having a shielded line run from the orchestra gallery of the first-class dining saloon, and one from the stage in the ballroom, the same sort of broadcast conditions apply as in any regular landline-outside-studio broadcast.

The set used is a four-tube one, each tube being one kw. plate input. Two tubes are used for rectifiers for the alternating current, one for oscillation, and one for modulation. The antenna radiation is 750 watts (10 amperes), and a regular broadcasting wavelength assigned by the U. S. Government is used. The antenna used for broadcasting is an auxiliary one, strung along the sides of the giant stacks—its length being 150 feet. It is a five-wire cage, as is also the main traffic antenna strung over the stacks between the masts—the latter being 600 feet long, however, and working on wavelengths of from 1,800 meters to 2,400 meters.

The actual object of these broadcasts is




Brown Brothers.

**The five-wire cage which is part of the antenna equipment of the Leviathan's broadcasting station**

As the Leviathan neared Europe, the crystal-set owners began to pick up the extra music that was being "put on the air," and letters began to pour in. Mr. Pickerill was so impressed by the enthusiasm of the European amateurs and broadcast listeners, that on his return trip he made a special point of broadcasting personal messages to as many as he could.

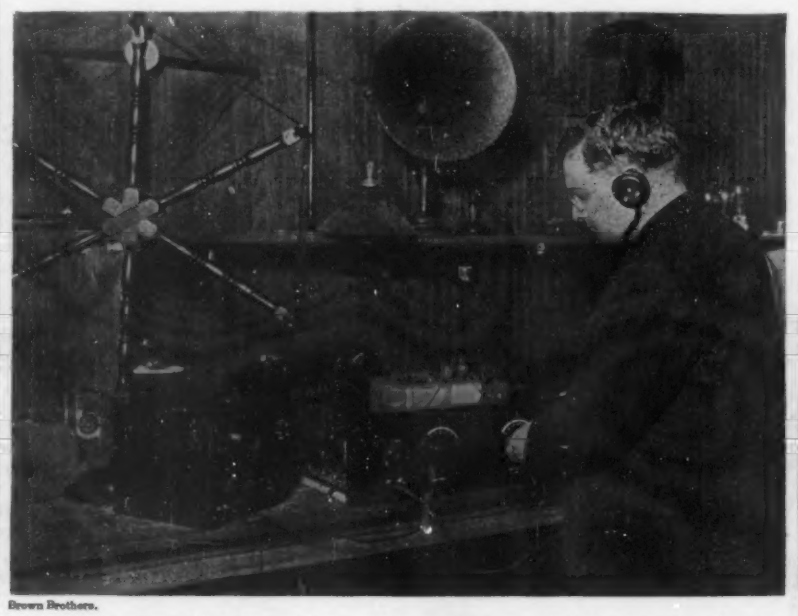
The set is, according to the Chief Radio Officer, the only one of its type put out by the Radio Corporation of America, being a combination telephony and telegraphy set which can, by the simple throwing of a switch to cut in the modulating tube, be

not one of publicity for the ship, but merely to ascertain clearly the possibilities of eventually establishing a radio-telephone communication system for use by the passengers. It would be of great use, Mr. Pickerill points out, to allow them to converse with other ships at sea, when the other ships will have installed such apparatus. But his real dream is the time when, two days out of Cherbourg, a passenger can walk into the radio office and telephone, via land-line relays, to his home or office in St. Louis or Detroit. Then, says the Chief, he will consider that radio has reached its highest practical use for the ocean traveler.

## The Piezo-Electric Oscillator

THERE is probably no more striking instance of the strange bypaths into which radio research has led investigators than the study of the electrical properties of rock crystals, a study which promises to have a far-reaching effect on the future of radio. Not that the rocks have been made to speak. Talking mountains still exist only in the minds of mythologists. But rocks, or rather rock crystals, have been made to control the frequency of oscillating circuits.

Piezo-electricity is the name that has been applied to this electricity produced by rock crystals. The first discovery was that crystals of quartz and of rochelle salt, when set into vibration, would produce weak electric oscillations. Further study of these remarkable phenomena revealed the fact that, when placed in an electric circuit which could be made to oscillate, the crystals controlled the frequency of oscillation.



Brown Brothers.

**Using the Piezo-electric oscillator as a wavemeter. The instrument is the small box at the left. The quartz crystal, used as the fundamental standard, is in the small flat case at the upper left-hand corner of the meter. The coupling coil projects from the upper right-hand corner. The meter on the front of the box shows when the incoming signal, from the receiver at the right, is in exact resonance with the standard frequency of the quartz crystal**

The principle of oscillating circuits in which the frequency of oscillation is determined by the inductance and capacity, or "tuning" of the circuit, is quite well known in these days when the various radio circuits are rivalled in number only by the crossword puzzles. When a proper crystal is placed in the circuit, however, the tuning is no longer governed solely by the inductance and capacity. Instead, the frequency depends on the length and thickness of the crystal.

The first to study the behavior of these crystals was Dr. W. G. Cady of Wesleyan University. The work was furthered by Dr. G. W. Pierce of the Cruft laboratory of Harvard University. Commercial applications have been worked out by the General Radio Company, of Cambridge, Massachusetts, in conjunction with Drs. Cady and Pierce. This company has placed on the market an oscillator for the production of constant radio frequency and these instruments will probably soon replace the present wavemeters used for frequency standards in the radio laboratories of the world.

Their advantages over standard wavemeters are numerous. They are compact. The entire oscillator, including batteries, is considerably smaller than a precision wavemeter. Furthermore the essential standard is the crystal, which may be carried in a vest pocket. The standard is also of greater permanence, inappreciably affected by temperature and shock. Once ground to the desired frequency it never requires rechecking. The frequency of the oscillator can be changed simply by plugging in a different crystal.

## Will Static Be Conquered?

THERE is no doubt that from the standpoint of the average radio listener the greatest objection to radio is the static. The term "static" should be interpreted, of course, to include all of the disturbances which produce the clicks, crashes crackles and other indescribable noises which afflict the listener, especially during the summer months. Some of these disturbances are man-made and originate in such things as X-ray machines, defective motors and dynamos and the like. But in the main these noises are natural and come from electric disturbances of various kinds originating in the atmosphere. Thunderstorms are among the chief offenders.

It is impossible, of course, to remove these disturbances from the ether. Man cannot command the lightning, at least not yet. And, at present, such noises are the chief obstacle to long-distance radio. At least three types of circuit—the regenerative, the neutrodyne and the superheterodyne—are capable of sufficient amplification to bring in stations 3,000 or 4,000 miles away every night if there were no noise due to static. The limit of radio is not the weakening of the wave with distance. It is the static—what the radio engineers call the "noise level" of the disturbances in the ether.

It is natural that much time and money has been spent in efforts to devise receivers which would respond to the desired signal and leave the static out. None of these attempts has succeeded. The problem is extremely difficult. The static consists, you see, of exactly the same kind of wave as the signal wave that you want to hear. The signal wave possesses, it is true, a definite frequency, determined by the wavelength of the transmitting station. Static does not. But the majority of the crashes or sizzles of static consist of *all* the wavelengths, or nearly all of them. It is as though a vast number of powerful transmitting stations, each on its own wavelength, were transmitting all at once.

Accordingly, no matter to what wavelength your receiver happens to be tuned, some of the static impulses passing continually through the ether will fit this wavelength, will be picked up by the receiver and will be heard as noise. To "tune out" the static has never been accomplished and is probably hopeless.

It is possible, however, to remove a part of the static by the device of the directional antenna. It is found, for example, that a majority of the static in the United States comes from certain definite regions, mainly the Gulf of Mexico and the mountains in

the northwestern part of Mexico and the southwestern part of the United States. Accordingly, if one can devise some antenna system which will pick up waves coming from only one direction, one can select out the signals arriving from other directions than the prevailing direction of the static. This can be accomplished to some extent by loop antennas and by the long, single-wire antennas devised by Mr. Beveridge and used in commercial radio reception.

Another possibility for the conquest of static has been suggested recently by devices invented by Dr. McCaa and described in recent issues of *QST*, the well-known publication of the American Radio Relay League. In these devices Dr. McCaa employs a series of balanced radio circuits so arranged that static crashes which are louder than the received signal cannot get through into the receiver and are not heard.

Static is not eliminated entirely. It is merely reduced in intensity so that it can never be louder than the wanted signal. The signal will be mixed, of course, with some static of the same loudness as itself. It is found in practice, says *QST*, that this mere decrease in the loudness of the static to the same level as that of the signal seems to the ear to be a great improvement. The signal is heard much better and the static often seems to disappear almost altogether.

## Keeping Stray Sounds Out of the Microphone

MANY radio fans who visit broadcasting stations or who see pictures of their favorite station in the papers wonder why it is that the rooms are so frequently hung with heavy curtains. Even the ceiling is often swathed with fold after fold of soft, heavy cloth. Such hangings have been taboo in dwelling houses for years. They are too dusty for comfort and far from sanitary. Why do the stations use them in the studios?

**A corner of CKAC, La Presse Studio, Montreal, Canada. Note the side curtains which can be closed or opened according to the requirements of acoustics and the folds of soft, heavy material on the ceiling which keep unwanted echoes out of the microphone**

The answer is a perfectly practical one. Such hangings absorb sound. They keep unwanted echoes out of the microphone. A good microphone has very little selectivity. It picks up all the sounds in its neighborhood, transmits them to the amplifiers and sends them out on the ether. If some one coughs in the studio or if a luckless announcer falls over a chair, the sound of it all goes out instantly to amuse the thousands of listeners. The story of the speaker who laid his watch so close to the microphone that its ticks nearly drowned out his speech is already familiar to all radio fans.

One of the most annoying sources of such stray sound in a studio room is the echo from the walls. The sound of a musical instrument or of a singer's voice will be sent back, more or less perfectly, from the side walls of a room, in much the same way in which echoes are produced by cliffs in the open air or by the walls and ceilings of the famous "whispering galleries" in buildings. These room echoes are not usually strong enough to be perceptible to the human ear. But the microphone gets them. With the amplification introduced by the transmitting apparatus, such studio echoes may utterly spoil the quality of the program sent out.

Hence the drapes on the walls and ceiling. The soft heavy cloth absorbs the sound. No echoes are created, or at least they are kept very feeble.

It is possible, of course, to so design a room and so to place the musician and the microphone in it that these room echoes are not created even although the walls are bare. There are materials, also, which can be used as wall coverings in place of wallpaper and which will absorb most of the sound waves so that echoes are minimized. These devices have been employed in some of the newest studio rooms, especially when the entire building is built for broadcasting purposes so that such matters can be taken into account when the construction is underway. But most stations are compelled to use rooms and buildings originally constructed for other purposes. In these cases the heavy hangings, dusty and germ filled as they are likely to become, are very nearly an absolute necessity.

## Sunset Affects Radio Wave Direction

AT last winter's meeting of the International Union of Scientific Radio, Dr. A. H. Taylor, of the radio research laboratory of the United States Navy reported some interesting conclusions from the long continued measurements of the direction of radio waves arriving at a given station at different times of the day. The waves came, of course, from a station the real direction of which was known. What was being investigated was the false variations of this real direction, as indicated by the measured direction from which the waves seemed to arrive.

It is possible, by well-known instruments, to determine the apparent direction of an arriving radio wave. Such instruments are used in the radio compass devices by which ships determine their positions at sea. Naturally, any false variations of these determined directions are very serious matters in radio compass service. The ship's captain might be seriously misled.

"It has been found," says Dr. Dellinger of the United States Bureau of Standards, in

reporting Dr. Taylor's communication to the meeting of the Union, "that a shift in the apparent direction of the waves from long wave stations occurs at sunset. The direction shifts toward the east before sunset, returns to normal at sunset, and then usually shifts to the west. The exact cause of this has not yet been fully determined but further experimental studies indicate that there is a combination of waves along the earth with waves reaching the receiving direction finder from a number of directions overhead, the whole effect being brought about by the change of ionization of the atmosphere as the sun sets.

Some variations of direction of broadcasting station transmissions have been found at night. At very high frequencies the changes of direction are very rapid and very great so that direction measurements are quite impossible."

**What standard quartz oscillators look like. At the left is an outside view of the case which contains the crystals and which is plugged in to the oscillator box. At the right are three of the standard crystals, differing in frequency according to size. The smaller crystals have the greater frequencies**

## Radio Ear Eczema

A GERMAN physician, Dr. H. Markus, states that many fans using ear phones develop "radio ear," a type of eczema. It appears that young people are particularly susceptible and this malady, if not recognized and treated properly in its early stages, is apt to develop into an obstinate and painful condition, which, in later stages, is hard to cure. Besides, it shows an inclination to spread to the ear channel and scalp.

The cause lies in the fact that the head pieces, fitting tightly against the ear, exert considerable pressure on the ear cartilage and render the skin more sensitive. Moreover, being non-absorbent, they prevent the evaporation of the natural perspiration which gathers under them. This causes a softening of the superficial skin layers which helps to produce ear eczema. There is trouble, also, from the fact that some of the cheaper ear phones in use in Europe contain anthracenic coal tar compounds which cause a disease of the tissue known as anthracen-scabies. Some cheap ear phones consist of compositions of phenol and formaldehyde, which still contain free cresol. This also may produce an inflammation of the skin or dermatitis.

Real hard rubber, produced by reliable manufacturers, does not contain these chemically active substances, but the pressure is still present. Small linen bags act as a prophylactic against skin infections, but it is still uncertain whether this relatively hard linen will be of any value in relieving the pressure. Earpiece covers made of sponge rubber remove the pressure on the ears and do not interfere so much with perspiration, since they are more or less porous. Recently such sponge-rubber earpieces have been made with an antiseptic impregnation, so as to avoid transmission of germs if the head pieces are used by several persons.

Doctor Markus concludes that "radio ear" is not an indispensable accompaniment of broadcasting, even where head pieces are used exclusively. It is advisable, however, to use such antiseptic "cushion phones" if any sign of painful and unsightly ear infection begins to develop.

## The Induction Loudspeaker

AT the recent radio show held in New York City, a large loudspeaker of an interesting type, namely, the Hewlett induction speaker, was employed to furnish the music from broadcasting stations. While the appearance of this new loudspeaker was responsible for attracting no little attention to it, the main attraction was the clear and lifelike reproduction of music with this device. To furnish sufficient volume of sound to fill the large exhibition hall and to do so without appreciable distortion, was a feat of the first

Wide World

**The British Board of Trade has ordered that in every ten lifeboats there must be one motorboat equipped with wireless. The sets used have a talking radius of 100 miles. The above photograph was taken on the steamship Orbita**

magnitude. This type of loudspeaker was illustrated and described in the columns of this magazine several months ago.

## Stopping Squeals with the Weagant Circuit

THE latest contribution towards the elimination of the radiation squeal of oscillating receivers comes from Roy A. Weagant, chief engineer of the DeForest Radio Company and well known for his many contributions to the radio art.

**The unique way in which Pasadena uses its public address system. The system is mounted on a truck and is housed in a bungalow. One of its uses is in connection with all public gatherings in the city's parks**

"The new invention can be easily applied to regenerative sets already constructed, at comparatively little expense," states the inventor, "and will absolutely prevent not only radiation, but the consequent disturbances due to it. So completely does this device effect this purpose that it is possible to work several regenerative receiving sets on one and the same antenna without mutual interference of any kind. It will prove a boon in the population centers with their apartments, flats and closely built up residential sections."

Dr. Albert Newburger

**A complete radio receiver in a lamp. One tries nowadays to build the whole receiving apparatus in as small a form as possible. This receiver, constructed in Paris, is a four-tube set, with both radio frequency and audio-frequency amplification. The movable loop-antenna is on the hoop surrounding the lampshade and is covered with silk. When the base of the lamp is closed and the loop placed horizontal no one would imagine that the lamp contains a complete radio receiver**

## New Collapsible Loop

A COLLAPSIBLE loop of German manufacture is proving highly popular among those who have loop receivers. This loop is 42 inches high and 40 inches wide. The inductance consists of fourteen turns of Litzendralt wire which is made up of 60 strands of No. 38 enameled copper wire woven into three cables, of 20 strands, which in turn are wound into one strand with double silk insulation.

The wire is connected into plots or sections to a series of binding posts located on the upright arm, giving a wavelength range of 100-400, 200-600, and 250-800 meters, with proper capacity control.

The method employed of not tapping the inductance but cutting the inductance, prevents dead-end losses.

The loop collapses into a small bundle which is then placed in a cylindrical container for portability.

## Radio Statistics to December, 1924

RADIO fans who enjoy calculating that their fellow citizens possess on the average one-fifteenth of a radio set apiece will find plenty of food for their mathematical inclinations in the following statistics compiled by the Radio Corporation of America, and corrected to December 9, 1924.

In a number of instances the figures given are admittedly no more than estimates, accurate figures being unobtainable, but they do show in most unmistakable terms the phenomenal growth of the radio industries in the United States and throughout the world during the past five years.

**Illuminating Facts on Radio**

| | |
|---|---|
| 1920 | $2,000,000 |
| 1921 | 5,000,000 |
| 1922 | 60,000,000 |
| 1923 | 120,000,000 |
| 1924 (partly estimated) | 350 000,000 |
| 1925 (estimated) | 450,000,000 |

EQUIPMENT IN USE

| | |
|---|---|
| Number of tube sets now in use, | 3,500,000 to 5,000,000 |
| Number of crystal sets in use, | 3,000,000 to 4,000,000 |
| Broadcasting stations in the United States | 538 |
| Broadcasting stations throughout world | 1,000 |
| Amateur transmitters in the United States | 18,000 |
| Ship-to-shore and commercial radio stations | 16,000 |
| Broadcast listeners in England | 800,400 |
| Broadcast listeners in the United States | 20,000,000 |

GENERAL STATISTICS FOR COMPARISON

| | |
|---|---|
| Homes now having radio equipment | 3,500,000 |
| Homes as yet without radio ment | 21,000,000 |
| Homes having phonographs | 9,000,000 |
| Homes without phonographs | 15,000,000 |
| Homes having automobiles | 12.800,000 |
| Homes without automobiles | 11,200,000 |
| Telephones in the United States | 14,347,395 |

# Notes and Queries

Conducted by Albert A. Hopkins

*This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.*

## The Recession of Niagara

H. S. McI. asks: *1. "What was the date upon which no water flowed over Niagara Falls?"*

*2. "How much do the Niagara Falls recede each year?"*

ANSWER: 1. On March 29, 1848, for one day only, no water flowed through the channel of the American Rapids and Falls, and again in 1908 and 1909 there was a stoppage of water for a short time due to a heavy ice jam at the head of the river.

2. The brink of Niagara Falls has moved about seven miles west in 30,000 years; the present rate of erosion is two and one-half to four feet a year in the Horseshoe Falls. The force of the water tears away the brink quicker in the Canadian concave than in the straight front of the American Falls.

## Do Patent Commissioners Ever Resign?

*M. & Co., of Chicago, wired us recently about this matter and we took particular pains to investigate. The following is what we found out:*

ANSWER: It is the impression in the Patent Office that no commissioner ever resigned his office for the reasons stated in Mather and Co.'s telegram, and it is believed that it is merely a legend relative to some assistant examiner.

In a commencement address in 1923, by Senator Copeland of New York, at North Carolina State College of Agriculture and Engineering, Raleigh, the doctor said:

"Fifty years ago the Commissioner of Patents appeared before Congress and gravely proposed that the Bureau of Patents be abolished. He said there was no need to continue it longer because everything that could possibly be invented had already been patented."

The present Commissioner of Patents replying to a letter inquiring as to the doctor's address wrote:

"The only foundation that I know for such a statement is a legend that fifty years ago one of the examiners in this office resigned his position since he thought the time would soon come when everything would be patented. How near he came to his guess may be seen from the fact that during the last two years this office has received about 9,000 patent and trade-mark applications each *month*."

## Wegener's Profile of the Atmosphere

B. A. J. says: *"Will you kindly give me some idea as to our atmosphere? I know that the air becomes rarefied as we leave the earth, but that is about as much information as I can get."*

ANSWER: Probably Wegener's profile of the atmosphere shown in the diagram on this page will enlighten you.

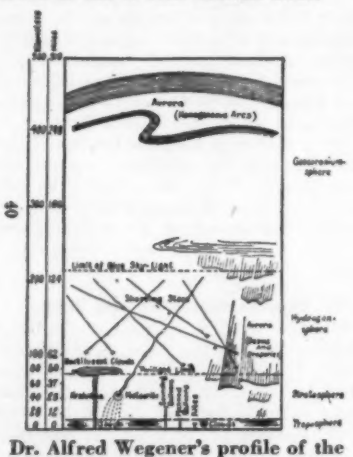
The lowest dotted line (about seven miles above the ground) is "where the air stops growing colder." It is the upper limit of ordinary clouds, of storms, and of balloon ascensions by human beings. Nearly all the moisture of the atmosphere lies below this level. Above this line comes the second layer of the atmosphere, the strato-sphere (also called the "Isothermal layer," because a thermometer carried up through it would show little change of temperature with change of elevation). This layer has been penetrated by sounding balloons, carrying meteorological apparatus but no human aeronaut, as far as twenty miles above the earth. At about fifty miles—the upper limit of twilight—begins a region in which the atmosphere consists chiefly of hydrogen. Near the lower border of this region clouds of fine dust have sometimes been observed, shining by reflected sunlight on summer nights. These "noctilucent clouds" are commonly explained as the product of volcanic eruptions on the earth (they were frequently seen after the eruption of Krakatoa), but may be of cosmical origin.

Concerning the uppermost regions of the atmosphere we have little positive knowledge. Above about 130 miles from the earth, Dr. Alfred Wegener, the author of this diagram, believes that a gas ("geocoronium") much lighter than hydrogen prevails, to which he attributes the characteristic green line in the spectrum of the higher auroras. This is hardly more than a guess at present.

## Legibility of License Plates

F. D. FARR asks: *"Is it true that the colors yellow and black have the greatest contrast, and that this combination of colors is best suited for traffic signals, roadside signs, and so on?"*

ANSWER: The Bureau of Standards, Washington, has made a number of tests on the legibility of various color combinations on license tags. These tests were made on automobile license tags submitted by several states, and show different types and sizes of numbers, spacings, and so on. The order of legibility obtained therefore cannot be considered as due to color contrast alone.




**Dr. Alfred Wegener's profile of the atmosphere shows the various strata, from the noctilucent clouds of the troposphere to the geocoroniumsphere, and above**

"The color combinations can be divided into two classes, but the actual order in each class is not necessarily accurate. The data are in fair agreement with the list of color combinations given in "Color and Its Applications," by M. Luckiesh. The color combinations in order of legibility as determined in these tests are:

| *Better Combinations* | *Poorer Combinations* |
|---|---|
| Green on white | Yellow on black |
| Black on yellow | White on red |
| Red on white | White on green |
| Blue on white | White on black |
| Black on white | |
| White on blue | |

## Blow-Holes in Babbitting

Mr. J. A. E. asks: *"Kindly let me know how I can run babbitt in a box so it will not run together and not leave any holes or blisters in the bearing."*

ANSWER: To avoid blow-holes and defects in babbitt linings, it is the practice of some of the large shops to cover the mandrel with a thin coating of clay wash by plunging it, while heated, into a pail of water containing, in solution, one or two pounds of Jersey red clay. When the mandrel is dry, the thin clay coating prevents the formation of bubbles, and the lining has a smooth surface. Oil causes the babbitt to blister. When babbitting solid bearings it is the practice in some shops to smoke the mandrel or cover it with paper to facilitate its removal from the bearing. For two-part bearings this is not necessary.

Before pouring, babbitt should be stirred thoroughly to insure a lining of uniform composition. Whenever practical, the bearing should be in a vertical position while pouring. The ladle should have a rounded spout rather than one which is sharp or broad. A broad thin stream, or one that is intermittent, tends to produce porous areas or blow-holes. Putty is preferable to clay for luting or sealing the ends of bearings, as the moisture in the clay tends to cause sputtering.

## The Use and the Misuse of Tools

A. A. G. writes: *"Can you give me some simple instruction for using household tools?"*

ANSWER: This is a good inquiry and we take pleasure in giving a few words on the use and abuse of the saw and the plane.

Tinkering with tools is a national habit. Most men have a few tools of one kind or another about the house. Few have had any training in their use, and so, very often, either misuse them or handle them to less effect than if they observed a few simple rules, deduced by centuries of carpenters and wood-workers.

The simple operation of sawing a board in two is a case in point. Like everything else to be done with tools, there is a right way and a wrong way, as plainly illustrated in the photographs. The man whose cross-cut saw is at an angle of about forty-five degrees with his work is sawing in the proper manner, while he whose saw is perpendicular is taking a great deal more strength for his work than he should take and going about the work in the very best way to saw it crooked and to make jagged splinters! Note how contorted the wrist in the picture is, while with the saw at the proper angle, the saw, handle, hand and forearm become mechanically one piece and the sawing is done entirely with the large biceps and triceps of the upper arm.

Sawing straight up and down tends to going crooked, because less bearing surface is provided for the saw in the saw cut. With the saw held on a slant, there is more saw in the saw cut, consequently the more easily it will stay "true." The perpendicular saw means splinters, because most boards are cut parallel with the grain of the log from which they were made. A slanting saw pulls and pushes the last few fibers so that they receive some support from their neighbors, while the perpendicular saw pushes them forth from the board, making an ugly splinter beneath the work.

Perhaps the plane is more often misused than the saw. All too often the amateur user of a plane handles it as if it were a combination draw knife, scraper and chisel, without any regard to the principles on which it is constructed. Of course, it is easier to use a plane held at an angle than one held straight with the direction of the cut, because holding it at an angle reduces the size of the shaving and therefore re-

quires less force to push it through the wood. But the evils which follow in the train of this angular holding of the plane are many.

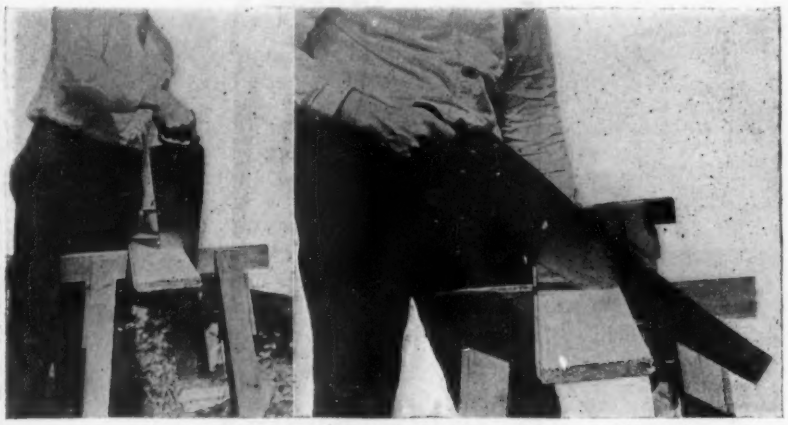
Wrong way to use an oil stone



Right way to use an oil stone

A plane is nothing but a chisel, held at the best angle for surface cutting and prevented from "biting" beyond a certain depth by the face of the plane. Now, in using a chisel to smooth off roughnesses on a board, no one would even try to hold it so that the blow of the mallet was in any other direction than the length of the chisel—to do so would be to risk marring the work and injuring the hand. Why, then, use a plane—which is nothing but a giant chisel properly held—so that the force of the blow (push) goes through the blade at an angle instead of straight? Solely for ease of working, and because it is less trouble. Yet, when it results in scoring the work, making an uneven surface, and sometimes "frittering" the wood (if it is a very loose grain) by picking up some of the fibers and pulling them loose, it would seem that there was little argument in favor of so doing.

Before you attempt to use a plane be sure that your plane iron (so called) is sharp. We show the proper angle. We will show the use and misuse of the bit-brace and the chisel in another issue.



An angle of forty-five degrees is best for sawing across the grain

## Gold Color on Sheet Metal

J. M. asks: *"Will you kindly favor us with a recipe of an acid dip to produce a fine matted imitation gold color on tin.*

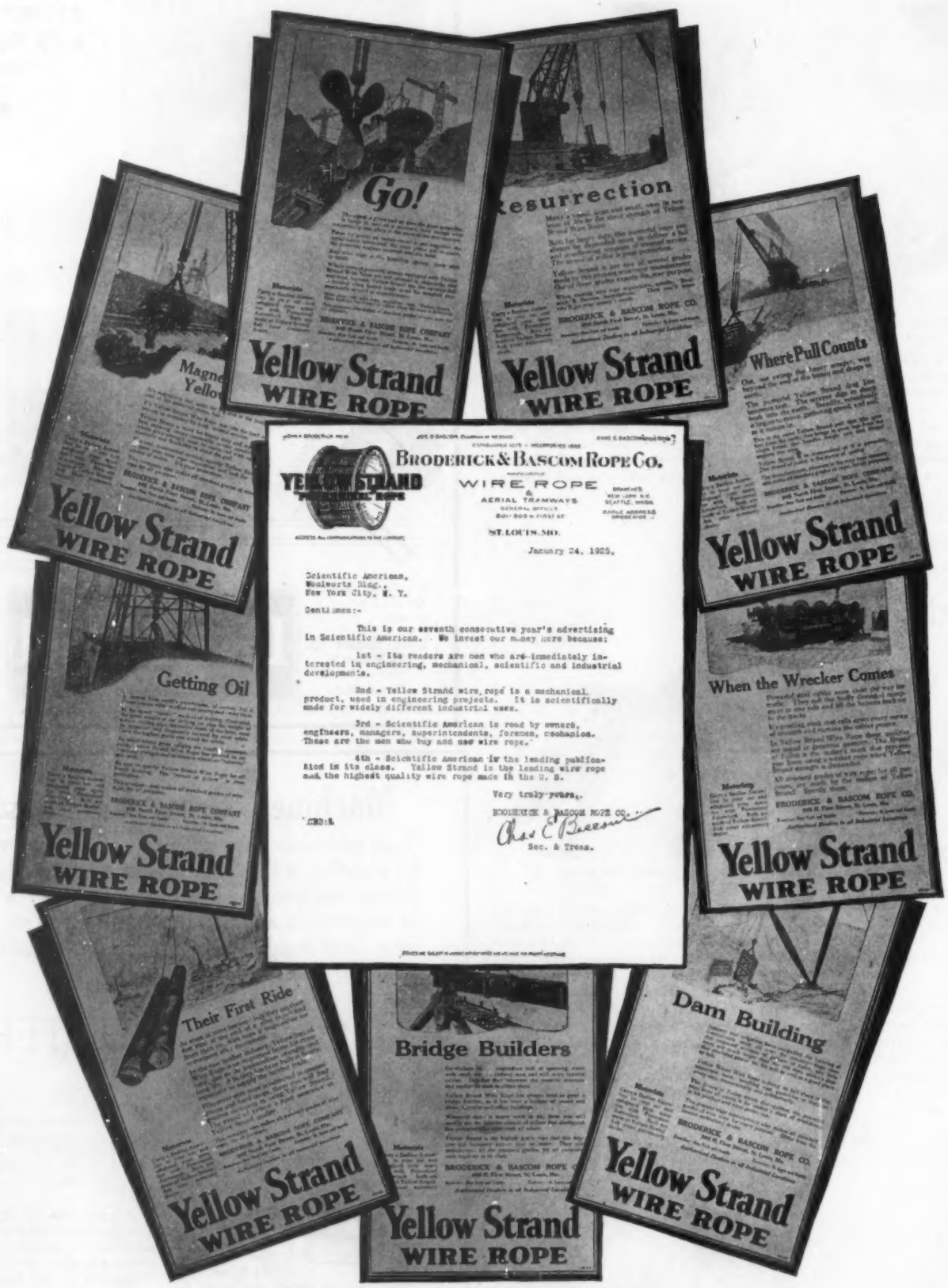
ANSWER: A hot dip made of equal parts of sulphuric acid and nitric acid can be made to produce a fine matted surface on the alloy you mention by adding a pound of oxide of zinc to each gallon of the acids. The addition of nitric acid makes the dip work coarse, while the addition of sulphuric acid makes the dip work slow and produces a fine matt.

Sheet brass is usually dipped in a hot dip made of equal parts of nitric acid, sulphuric acid and water until the metal is free from fire stains; then matt dipped, rinsed, then dipped in a bright dip for a few seconds and rinsed in cold water. After the metal has been through the acid dips it is usually passed through a cyanide dip, then rinsed in clean cold water, then dried or treated as desired.

The bright dip is made by using equal parts of sulphuric and nitric acids with about eight ounces of hydrochloric acid or common salt for each three gallons of dip. The cyanide dip should contain about four ounces of sodium cyanide for each gallon of dip.

Wrong way to hold a plane

Right way to hold a plane

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# The Book Department

**Louis S. Treadwell, *Manager***

We make somewhat of a departure from our usual line in some of the books listed below, believing that vacation plans quite necessarily include literature of collateral interest.

| | |
|---|---|
| **Automobile Blue Book—** | |
| Vol. I —New York-New England | $3.20 |
| II —Middle Atlantic-South East | 3.20 |
| III—Middle Western | 3.20 |
| IV—Western-Transcontinental | 3.20 |
| **Bird Life** by Chapman | 4.20 |
| **Butterflies** of the Eastern U. S. | 2.15 |
| **Camp Cookery** by Kephart | 1.15 |
| **Canoe,** Selection, care, etc., by Pinkerton | 1.15 |
| **Camping,** Auto, by Brimmer | 2.15 |
| **Campcraft,** Motor, by Brimmer | 1.75 |
| **Camps,** Skyline, by Eaton | 2.65 |
| **Holidays in Tents** by Childs | 2.15 |
| **Vacation on the Trail** by Davenport | 1.65 |
| **Roughing It Smoothly** by Jessup | 2.65 |
| **Cabins,** Log, and Cottages by Wicks | 2.15 |
| **Fish and Fishing,** The Book of, by Rhead | 2.15 |
| **Dry Fly and Fast Water** by Branch | 2.15 |
| **Angler,** The Complete, by Walton | 3.65 |
| **Football,** American, by Daly | 2.15 |
| **Football,** Principles of, by Heisman | 2.65 |
| **Golf,** Gist of, by Vardon | 2.15 |
| **A Guide to Good Golf** by Jim Barnes | 2.15 |
| **Line O' Gowf or Two** by Taylor | 2.15 |
| **Photography,** Practical, Amateur, by Davis | 2.15 |
| **Photography** for the Amateur by French | 3.65 |
| **Photography,** Outdoor, by Dimock | 1.15 |
| **Theory of Development** by Nietz | 2.65 |
| **Tennis,** Lawn, Art of, by Tilden | 2.15 |
| **Tennis** Singles and Doubles by Tilden | 2.15 |
| **Swimming** Lessons, Practical, by Bruce | 2.15 |
| **Swimming and Diving** by Barnes | 1.65 |
| **Standardized Plant Names** | 5.20 |
| **Rifles** and Rifle Shooting by Askins | 1.15 |

### Novels

| | |
|---|---|
| **God's Stepchildren** by Millen | 2.15 |
| **That Nice Young Couple** by Hackett | 2.15 |
| **Illiterate Digest** by Will Rogers | 2.15 |
| **Fish and Actors** by Sutton | 2.15 |
| **That Markham Affair** by Hyatt | 2.15 |
| **Lucky in Love** by Bertha Ruck | 2.15 |
| **Here Comes the Bride** by Irvin S. Cobb | 2.15 |
| **Going on Fourteen** by Irvin S. Cobb | 2.65 |
| **The Green Hat** by Arlen | 2.15 |

All prices are postpaid

### Steam Turbines

**By J. A. Moyer**
Dir. Mass. Dept. Univ. Ext.

A practical and theoretical treatise covering all phases of up-to-date practice for the student and practicing engineer. Published by John Wiley & Sons, Inc. $4.20 postpaid.

### John A. Brashear

The autobiography of a man who loved the stars and was recognized as the world's foremost living authority on astronomical lenses and instruments of precision. Published by Houghton Mifflin Co. $4.20 postpaid.

### Masters of Science and Invention

**By F. L. Darrow**

Brief biographies of some fifty leading scientists, from Galileo to Einstein, shown against the background of the ideas of their time, working out each individual discovery. Published by Harcourt Brace & Co. $2.25 postpaid.

### Diesel and Oil Engineering Handbook

**By Julius Rosbloom**

The 1925 edition of this very important and successful work includes new matter on Diesel electric locomotives, Diesel automobiles, Diesel motorcycles, Diesel shovels, Diesel rollers, etc. The oil industry is completely covered from recovery to utilization. $5.15 postpaid.

### Atoms and Electrons

**By Sir Oliver Lodge**

Reviewed in last issue Scientific American Digest. Published by George H. Doran. $3.20 postpaid.

### Seventy Years of Life and Labor

**By Samuel Gompers**

This autobiography is a record of the development of the labor movement, of exceeding human interest and broad understanding. It emphasizes the worth of a most unique and powerful personality. In two volumes. Published by E. P. Dutton Co. $10.00 postpaid.

### Automobile Engineering

**By Various Experts**

Five volumes covering the essential and newest features in extenso. Separate equipment data and specification sheets and wiring diagrams for each car. Thorough, practical and understandable. Especially valuable for the trade. Bound in flexible fabrikoid. Published by American Technical Society. $19.80 postpaid.

### Automobile Starting, Lighting and Ignition Systems

**By V. W. Page**

This revised and enlarged edition indicates the latest practice by illustrating the various installments on standard makes of automobiles. Comprehensible and complete. Published by N. W. Henley Pub. Co. $3.20 postpaid.

***[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]***

## "High Tides"

F. D. T. asks: *"In what foreign countries and in what localities is there a mean range of tide of fifteen feet or more?*

ANSWER: This being a very special query we were obliged to invoke the good offices of the United States Coast and Geodetic Survey. The director, Mr. E. Lester Jones writes us as follows: "In compliance with your request, I take pleasure in furnishing you with the following list of places in foreign countries where the mean range of tide is fifteen feet or more:

Canada—Cumberland Sound, Frobisher Bay, Hudson Strait, St. Lawrence River (vicinity of Island of Orleans) and Bay of Fundy;
Mexico—Gulf of California (northern end);
Brazil—Northern coast, vicinity of Maraca Island;
Argentina—Numerous places between Gulf of San Matias and San Sebastian Bay;
Chile—Magellan Strait (eastern end) and Gulf of Ancud (Reloncavi Sound);
Korea—Chemulpo (Inner Harbor);
China—Min River to Hungwha Sound;
Australia—Northwestern coast;
India—Gulf of Cambay (northern part);
France—English Channel;
British Islands—Numerous places along the coasts;
Russia—White Sea (entrance).

"The Tide Tables published annually by this Survey give in addition to the predicted times and heights of the tide for each day in the year at 83 principal ports, the mean and spring ranges of the tide for more than 3,500 localities in various parts of the world. The Tide Tables for the United States and Foreign Ports are sold for seventy-five cents per copy and may be purchased from any of our agencies or direct from this Survey."

## The Year in Psychology

P. W. H. asks: *"Will you please mention the most outstanding feature of this year's development in psychology, any event of importance as a contribution toward the science of the soul.*

ANSWER: The answer to this query depends upon what is meant by psychology. Matters pertaining to psychic phenomena, to spiritism, and some forms of the so-called occult, come, tentatively, under the heading of psychology. Ordinarily, however, when we say psychology we refer to a science. Not all psychic phenomena have yet been reduced to a science—far from it. Therefore psychology is commonly considered to connote that portion of the general category just described which has been brought down relatively close to demonstrable science, chiefly by the universities in laboratory experimentation.

"The Story of Man's Mind," by George Humphrey (Small, Maynard and Co., Boston) covers in an interesting and readable manner the scientific portion (*Scientia*, Latin word meaning knowledge) of psychology.

Certain forms of occultism, like astrology and palmistry, are often confused with psychology. These "sciences" exist as such only in imagination.

## Shrinkage of Wood

A. L. N. *asks for information on the shrinkage of wood.*

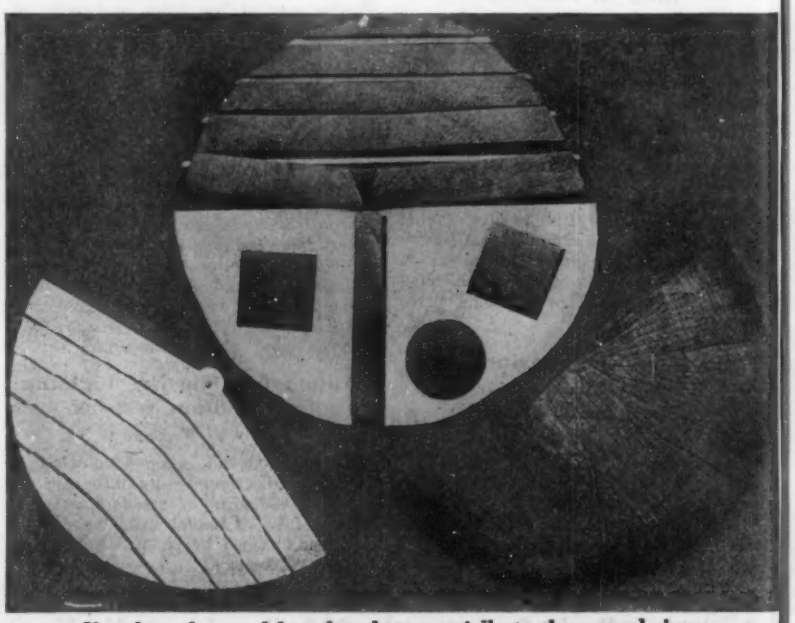
ANSWER: The accompanying picture shows graphically how wood shrinks. Sections of oak which have been cut from the log and kiln-dried have been laid on sections of black paper which show their original size, shape, and position in the log before drying.

The length of the log is not represented because of the fact that the shrinkage which occurs along the length of boards or timbers is negligible in normal wood. It can be seen that considerable shrinkage has taken place in the direction of lines radiating from the center of the log, and that the maximum shrinkage has occurred parallel or tangential to the annual rings seen on the log end.

In oak the ratio of tangential shrinkage to radial shrinkage is two to one. The fact that the quarter-sawed board shown here shows so little shrinkage explains a part of the popularity of quarter-sawed material for making articles such as furniture and cabinet work, in which shrinkage would be a serious disadvantage. The plain-sawed board nearest the center of the disk is cupped most because its inner side is practically of the quarter-sawed (radial) type, while its outer side is of the tangential type. As a result of the tension set up by the outer face pulling against the more stable face, the board has been considerably distorted.

A tree is made up for the most part of tiny elongated hollow fibers, with their lengths parallel to the length of the tree. These fibers or cells, in drying, shrink in girth but not appreciably in length after all free moisture has left the cell and moisture begins to be taken from the cell walls. Running out horizontally from the center of the tree are the chains of similar, specialized food-storing cells seen here as tiny white lines radiating from the center of the disk. These medullary rays also appear where they enter and leave the plane of the saw on quarter-sawed oak as large lustrous flakes. It is the slight amount of shrinkage along the lengths of the fibers in these horizontal rays which prevents the vertical cells from shrinking equally in all directions toward the center of the log.

The excess of shrinkage along the annual rings over that from the bark inward is what causes the heavy seasoning checks on the ends of logs and what has caused the radiating checks on the disk here.



**Note how the wood has shrunk tangentially to the annual rings**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## JUNE 1925

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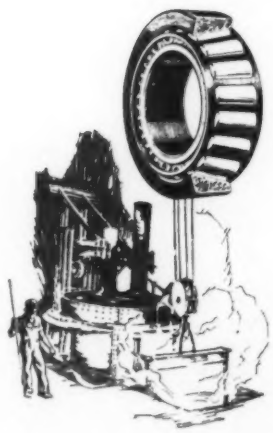
# It's in the Steel, too!



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